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# Energy Research Abstracts

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Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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# Energy Research Abstracts

## Coverage

*Energy Research Abstracts (ERA)* provides abstracting and indexing coverage of all scientific and technical reports and patent applications originated by the U.S. Department of Energy, its laboratories, energy centers, and contractors, as well as theses and conference papers and proceedings issued by these organizations in report form. Audiovisual materials, computer media (magnetic tapes, diskettes, etc.), and engineering drawings are included in this definition. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations, *provided* that the full text of the document has been received by OSTI. Foreign report information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. The purpose of this publication is to announce documents produced or obtained by DOE that are not so readily available as journal articles, books, or patents. Please note that beginning with the January 1991 issue, *ERA* does not cover nonreport literature.

## Scope

The scope of *ERA* encompasses DOE's research, development, demonstration, and technology programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

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*Managing Editor,* Doris M. Henline
*Technical Editor,* Robert W. Rutkowski

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- Finland
- France
- Federal Republic of Germany
- Italy
- Japan
- The Netherlands
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

The **International Nuclear Information System (INIS)** was established to promote the exchange of information on nuclear science and technology. Its operation is similar to that of the ETDE, with the INIS Secretariat being located in Vienna, Austria. Currently, 79 countries and 15 international organizations are members of INIS. OSTI serves as the INIS national center for the United States.

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The principal data elements included in these citations are:

1. **Abstract number** within volume.
2. **Report number** identification for report-type literature.
3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Date of publication.** If not known, a processing date is in brackets.
9. **Number of pages** or page range. Prices are based on total pages unless special pricing applies.
10. **Language** of document if non-English.
11. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
12. **Sponsoring organization.**
13. **Contract or grant number.**
14. **Secondary identifying number;** may be a conference number.
15. **Conference title, location, and date,** if applicable.
16. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
17. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
18. **Drop note** or explanatory statement.
19. **Abstract.**
20. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

## Sample Citations

***Report***

**18494** (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

***Report Analytic***

**18500** (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

54 (DOE/ER/60888-1-Vol.1, pp. 115-117) **Investigation of air pollution in house due to use of various fuels.** Luo, Dayu (Chengdu Sanitation (China)). Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1990. (CONF-900724-Vol.1: Indoor Air '90: 5th international conference on indoor air quality and climate, Toronto (Canada), 29 Jul - 3 aug 1990). In Indoor air '90: The fifth international conference on indoor air quality and climate. Volume 1: Final report. 786p. Order Number DE90017786. Source: NTIS.

Air pollution in houses caused by combustion of coal is more serious than that by combustion of natural gas and methane (primarily by $SO_2$ and $NO_2$). The gas concentration after cooking is higher than that before cooking, and it is higher in kitchen than in bedroom and outdoor. There were mutations in the extract from TSP in $30m^2$ air in the bedroom, kitchen and outdoor, where coal and natural gas were used. The supernatant saliva activity of children whose family uses coal is significantly lower than that of pumping streams.

# How To Order from the Availability Sources

## TO OBTAIN A REPORT

**Report literature,** usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 2 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) OSTI prices are based on total pages unless special pricing applies. The public should order from NTIS or from one of the other agencies listed in the citation. NTIS price codes may continue to appear in some records. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

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**INIS** *Available only in microfiche.*
INIS Clearinghouse
International Atomic Energy Agency
P.O. Box 100, A-1400
Vienna, Austria

**NTIS** U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

**OSTI** U.S. Department of Energy
Office of Scientific and Technical Information
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Oak Ridge, TN 37831

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Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts*. Descriptions of entries in these indexes follow.

**Corporate Author Index**
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

**Wisconsin Univ., Madison (USA). Dept. of Physics**
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
**Wisconsin Univ., Madison (USA). Lab. of Genetics**
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

**Personal Author Index**
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

**Hadley, D.L.,** *See* Lee, A.D., 15:17651
**Haeberli, W.,** [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

**Subject Index**
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

**HYDROGEN ISOTOPES**
*See also* DEUTERIUM
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TRITIUM
**Neutron-Rich Isotopes**
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

**Contract Number Index**
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

**FG02-88ER40438** **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
**FG02-88ER60664** **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**

**Report Number Index**
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

**DOE/ER/40438–**
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# Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 39 first-level and the 308 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past monthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in ETDE/PUB-1-R1, *International Energy: Subject Categories and Scope*.

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# Energy Research Abstracts

## 01 COAL, LIGNITE, AND PEAT

### 0103 Preparation

*Refer also to citation(s) 33596, 33607, 33610, 33611, 33612, 33613*

**33541** (DOE/PC/79892–T15) **Development of the chemical and electrochemical coal cleaning process: Thirteenth quarter technical progress report, April 1, 1991–June 30, 1991.** Basilio, C.I.; Yoon, Roe-Hoan. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Mining and Minerals Engineering. [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79892. Order Number DE92000330. Source: OSTI; NTIS; GPO Dep.

Studies concerning the use of flotation as an alternative method of separating liberated mineral matter from chemical/electrochemical coal cleaning (CECC) treated coal were continued using Elkhorn No. 3 coal. The results obtained using different methods of recovering the clean product after CECC treatment showed trends similar to those observed previously with Pittsburgh No. 8 coal. The use of flotation after CECC treatment of the Elkhorn No. 3 coal was found to be more efficient than wet-screening. Construction of the continuous bench-scale unit was completed in this quarter. The unit was modified to process 2 lbs/hr instead of the original design of 1 lb/hr so as to ensure efficient operation of the vacuum filter unit. Start-up of the continuous unit was successfully conducted and shakedown testings were started. Initial results show that the continuous unit was able to reduce the ash content of a recently acquired Wyodak coal sample to as low as 1.16%. 2 tabs.

**33542** (DOE/PC/89758–T4) **Surface electrochemical control for fine coal and pyrite separation: Technical progress report, April 1, 1991–June 30, 1991.** Hu, Weibai; Huang, Qinping; Riley, A.; Zhu, Ximeng; Bodily, D.M.; Liang, Jun; Zhong, Tinghe; Wadsworth, M.E. Utah Univ., Salt Lake City, UT (United States). Dept. of Metallurgy and Metallurgical Engineering. [1991]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89758. Order Number DE92000341. Source: OSTI; NTIS; GPO Dep.

This technical progress report, prepared in accordance with the reporting requirements of DOE Project No. DE-AC22-89PC89758, covers the work performed from April 1, 1991 to June 30, 1991. The ongoing work includes the characterization of coal pyrites, the floatability evaluation of three typical US coal samples, the flotation behavior of coal pyrites, the electrochemical measurement of the surface properties of coal pyrites, and the characterization of species produced at pyrite surfaces. 6 refs., 20 figs.

**33543** (DOE/PC/90174–T3) **Development of the selective coagulation process: Third quarterly technical progress report, April 1, 1991–June 30, 1991.** Yoon, R.H.; Luttrell, G.H. Virginia Center for Coal and Minerals Processing, Blacksburg, VA (United States). [1991]. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90174. Order Number DE91018662. Source: OSTI; NTIS; GPO Dep.

Recent studies have resulted in the development of a novel agglomeration process for upgrading ultrafine coal. This process, which is known as selective hydrophobic coagulation (SHC), is based on the new finding that hydrophobic coal particles can be selectively coagulated in the presence of dispersed mineral matter. The driving force for the coagulation is believed to be due to the structural arrangement of water molecules near the coal surface. In most cases, simple pH control is all that is required to (1) induce the coagulation of the coal particles and (2) effectively disperse the particles of mineral matter. During the past quarter, several important aspects of the SHC process were examined. Direct measurements of the surface forces which control the selective coagulation process were conducted using a Mark 4 surface force apparatus. These preliminary measurements have provided irrefutable evidence for the existence of the hydrophobic force. Key expressions have been presented for a population balance model describing the hydrophobic coagulation process. In order to validate this model, experimental measurements of the size distributions of coal coagulation have been initiated. The liberation characteristics of samples obtained from the Elkhorn No. 3 and Pittsburgh No. 8 coal seams were determined using a SEM-IPS image processing system. Mixing studies were carried out to determine the effects of mixer-impeller configurations on the coagula size distributions. Bench-scale continuous testing has also been initiated during the past quarter using a rotating drum screen and sedimentation tank. 25 figs., 8 tabs.

**33544** (DOE/PC/90176–T44) **Process development for production of coal/sorbent agglomerates: Technical report, March 1, 1991–May 31, 1991.** Rapp, D.M. (Illinois State Geological Survey, Champaign, IL (United States)); Lytle, J.M.; Hackley, K.C.; Moran, D.L.; Becvar, S.; Berger, R.L.; Griggs, K. Illinois State Geological Survey, Champaign, IL (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90176. Order Number DE91018308. Source: OSTI; NTIS; GPO Dep.

The objective of this work is to pelletize these fines with a sulfur capturing sorbent such as calcium hydroxide to produce a fuel which will meet future sulfur dioxide emission levels. To decrease binder costs, carbonation, which is the reaction of calcium hydroxide with carbon dioxide in the presence of moisture to produce calcium carbonate, is being investigated as a method for improving pellet quality. The calcium carbonate formed acts as a cementitious matrix which improves pellet strength. Two potential combustion options are being considered – fluidized bed combustors and industrial stoker boilers. During this quarter a pellet characterization test program was conducted using a fine coal (-28 mesh) concentrate collected from a southern Illinois preparation plant. Results indicate that carbonation produces significant improvements in compressive strength, impact and attrition resistance and weatherability. Also, 20 combustion tests were conducted on pellets formed with 0, 5 and 10% levels of calcium hydroxide (10% calcium hydroxide is a 2.3:1 Ca/S ratio for this sample). Tests were conducted at 850 and 1350 °C. Chemical analyses of the combustion residues are not yet complete so results will be reported next quarter. 8 refs., 7 tabs.

**33545** (DOE/PETC/TR–91/9) **Baseline performance evaluation of micronized-magnetite cycloning.** Klima, M.S.; Killmeyer, R.P. USDOE Pittsburgh Energy Technology Center, PA (United States). Coal Preparation Div. Jun 1991. 41p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018699. Source: OSTI; NTIS; GPO Dep.

In 1989, a series of 30 laboratory-scale micronized-magnetite (minus-10 microns) cyclone test were carried out at the US Department of Energy's (DOE) Pittsburgh Energy Technology Center (PETC) to investigate the performance of this process in cleaning 600 x 38 micron coal. Some of the key variables studied included magnetite particle size, cyclone inlet pressure, feed-coal particle size range, relative density of the medium, and medium-to-coal ratio. The performance was analyzed in terms of both distribution curves and ash and pyritic sulfur values. The results demonstrated that micronized-magnetite cycloning can achieve sharp separations down to as fine as 38 microns with correspondingly good reductions in both ash and pyritic sulfur content. The report provides the detailed cyclone data for this series of tests. 19 refs., 3 figs., 4 tabs.

**33546** (KTM/E-B–89) **ADEWA Artificial dewatering of peat: Interim report 1988-1990.** Pirkonen, P. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab.). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 51p. Project KTM-356/881/86. Order Number DE92704051. Source: OSTI; NTIS (US Sales Only).

Finland's energy research programmes. Published also in Finnish Report no B:88.

The overall aim of the ADEWA research program me is to develop a peat production technique based on artificial dewatering. One of the more specific research objectives is to reach, in an economically viable way, a 35 % dry matter content through mechanical dewatering. In order to carry out fundamental research on the mechanical dewatering process, a multi-purpose, computer-controlled piston press was constructed. Basic dewatering research addressed the process of dewatering in separately screened peat fractions, partial hydrolysis, the effects of the electric and ultra-sound fields, and, in particular, the use of chemicals. An inexpensive method (FIM 20 T/DS) was discovered for the chemical processing of the slurry made from Carex peat. Of the commercial dewatering techniques, the UltraPresse press was investigated. As regards drying techniques, applicability studies were done on steam drying, and experimental pilot-scale studies on condenser drying, as well as on multi-faceted evaporation of the Carver-Greenfield type. The studies indicate that steam drying is a viable method of dewatering peat with 65 % moisture content at power plants whose electric power is 150 MWe (400000 DS/a). Condenser drying, on the other hand, turned out to be a totally unsuitable method for peat both from the technical and economical point of view. The Carver-Greenfield process was technically quite functional but economically unviable.

## 0104 Processing

*Refer also to citation(s) 33541, 33542, 33544, 33590, 33600, 33621, 33622, 33623, 33624, 33625, 33626, 33627, 33628, 33629, 33851, 33966, 33967, 33973, 34394, 34529, 34728, 34745, 34752*

**33547** (BNL–46562) **Economical clean carbon fuel and co-product gaseous and liquid from coal: The value of a HYDROCARB coal refinery in competing with oil and gas in the current fuel markets.** Steinberg, M. (Brookhaven National Lab., Upton, NY (United States)); Grohse, E.W. Brookhaven National Lab., Upton, NY (United States). Jul 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-911041–3: 8. annual international Pittsburgh coal conference: coal - energy and the environment, Pittsburgh, PA (United States), 14-18 Oct 1991). Order Number DE92000131. Source: OSTI; NTIS; GPO Dep.

Unlike its predecessors, the HYDROCARB Process converts coal or other carbonaceous feedstock to a clean carbon fuel and co-product gaseous hydrogen- and/or methane ($CH_4$)-rich gas and/or liquid methanol. Feedstock carbon content is essentially extracted as pure particulate carbon, free of sulfur, nitrogen, and ash. By eliminating the need to manufacture large quantities of hydrogen, lower capital cost and higher thermal efficiency result compared to previous coal-to-synthetic-fuel processes, allowing production of carbon fuel and at a price competitive with current energy prices. Combustion testing has shown that carbon fuel can be burned in conventional combustion and heat engine equipment with minimum modification. The HYDROCARB Process also can reduce $CO_2$ emissions for mitigating the greenhouse problem. 5 refs., 1 fig., 2 tabs.

**33548** (DOE/FE–0240P) **Report to Congress: Coal refineries: A definition and example concepts.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (United States). Jul 1991. 259p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91017915. Source: OSTI; NTIS; GPO Dep.

A definition of the term "coal refinery" is offered and twenty-seven coal refinery concepts are identified and described. These concepts were selected as being representative of the many possible variations of coal refinery concepts that are possible. The status of development of the different coal refinery descriptions ranges from conceptualized processes in the laboratory stage to integrated processes which are being demonstrated at near commercial scale. The extent of the descriptions ranges from a short summary of the basic processes involved and products produced to more detailed discussions of the processes, coal feeds, environmental aspects, status of development, and research needs. The concepts are grouped into one of four categories and a summary discussion of status and research and development needs for each category is provided. Comments pertinent to the research and development needs for coal refineries in general are also provided. 11 refs., 4 tabs.

**33549** (DOE/MC/23075–2973, pp. 65-96) **Fundamental high-pressure reaction rate data.** Germane, G.J. (Brigham Young Univ. Provo, UT (USA)); Blackham, A.U. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The overall objectives of this subtask are to measure and correlate fundamental reaction rate coefficients for pulverized-coal char particles as a function of char burnout in oxygen at high temperature. The effect of high pressure will be investigated. The specific objectives for the third year reporting period include: (1) review appropriate literature in pertinent areas; (2) complete the HPCP reactor and support systems for char preparation and oxidation studies; (3) continue the preparation and characterization of chars from the coals selected for this study, using the hot-tube reactor for char production; (4) produce chars in the HPCP under controlled conditions for oxidation tests and for comparison with chars from the hot-tube reactor; (5) develop the char oxidation test plan; (6) conduct oxidation tests in the HPCP reactor with chars produced from several of the coals selected for study. No additional work on sorbent capture was performed during the reporting period because of the focused allocation of reduced resources to complete the main thrust of this subtask. Three components of the subtask have been identified to accomplish the objectives: (1) design and construct a laminar-flow, high-pressure, controlled-profile (HPCP) reactor, (2) prepare char at high temperature and pressure, and (3) determine the kinetics of char-oxygen reactions at high pressure. The HPCP reactor, capable of functioning at 400 psi (27 atmospheres), has been constructed to perform the fundamental reaction rate measurements required for the study. Data from another char oxidation study (atmospheric pressure) conducted at Brigham Young University will also be used.

**33550** (DOE/MC/23075–2973, pp. 97-126) **Secondary reaction of pyrolysis products and char burnout submodel development and evaluation.** Serio, M.A. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The objective of this subtask is to develop and evaluate by comparison with laboratory experiments, an integrated and compatible submodel to describe the secondary reactions of volatile pyrolysis products and char burnout during coal conversion processes. Experiments on tar cracking, soot formation, tar/gas reactions, char burnout, and ignition will continue during Phase 2 to allow validation of submodels in Phase 2. During this year, both pyrolysis and combustion experiments were continued in the Transparent Wall Reactor (TWR). Characterization of the TWR system with regard to air and particle velocities, gas temperature profiles, coal volatile weight loss, and char burnout as a function of distance from the nozzle was also done. A series of pyrolysis experiments was done with Zap lignite and Pittsburgh Seam bituminous coal. The particle temperature measurements were used to reconstruct the particle temperature-time history. The pyrolysis yields were then simulated with the FG-DVG model.

**33551** (DOE/MC/23075–2973, pp. 152-168) **Large particle submodels.** Serio, M.A. (Advanced Fuel Research, Inc., East Hartford, CT (USA)). Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The objectives of this task are to develop or adapt advanced physics and chemistry submodels for the reactions of large coal

particles. (i.e., particles with significant heat and/or mass transport limitations) and to validate the submodels by comparison with laboratory scale experiments. The result will be coal chemistry and physics submodels which can be integrated into the fixed-bed (or moving-bed) gasifier code to be developed by BYU in Subtask 3.b. The main activity related to the single particle model development was to investigate how to incorporate secondary reactions of tars in thick beds, which are important in fixed-bed gasification and in mild gasification. One approach to getting additional data on the processes which occur in thick beds was to do FT-IR and FIMS analyses on tars produced by rapid heating in an entrained flow reactor at AFR and tars produced by slow heating in a fixed bed at METC. The main modeling activity during the past year was to develop a revised version of the FG-DVC model which does not have a lot of extraneous variables which have accumulated over many years of development. Work resumed on the AFR fixed-bed reactor experiment. The redesigned reactor system was reassembled and hot tested. Some preliminary coal pyrolysis experiments were done with Zap lignite coal and with three bituminous coals. The system appears to function properly except for small amounts of $O_2$ and $H_2O$ contamination.

**33552** (DOE/MC/23075–2973, pp. 257-275) **Comprehensive fixed-bed modeling review, development, evaluation, and implementation.** Radulovic, P.T. (Brigham Young Univ., Provo, UT (USA)); Smoot, L.D. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The objectives of this subtask are: (1) to develop an advanced fixedbed[1] model incorporating the advanced submodels being developed under Task 2, particularly the 1 large-particle submodel (Subtask 2 e.), and (2) to evaluate the advanced model. During the past year, work continued on reviewing numerical techniques used in comprehensive moving-bed models, obtaining validation data from the literature, and coding of a 1-D moving-bed model. Three equilibrium-based subroutines and a 1-D, moving-bed code were written, debugged, and partially validated. The three equilibrium subroutines are based on total equilibrium, 1-zone partial equilibrium, and 2-zone partial equilibrium. The partial equilibrium subroutines used the functional group (FG) model to predict ultimate volatiles composition (including tar) and either the 2-step or FG model to predict ultimate volatiles yield. The equilibrium subroutines predict reasonable effluent properties and are used to provide an initial guess for the 1-D moving-bed code. The 1-D code has two options: 2-zone and 1-zone. The 2-zone option assumes that devolatilizatiuon occurs instantaneously in a separate zone. The 1-zone option assumes that devolatilization and char oxidation/gasification occur simultaneously in the reactor.

**33553** (DOE/MC/23075–2973, pp. 279-289) **Application of fixed-bed code.** Radulovic, P.T. (Brigham Young Univ. Provo, UT (USA)); Smoot, L.D. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The objective of this subtask is to apply the advanced fixed-bed code developed in Subtask 3.b to simulate fixed-bed gasifiers of interest to METC. During Phase I, two test cases will be selected, data for validation of these test cases will be obtained, and initial testing and validation of the code will be performed. Data collection was initiated on fixed-bed gasifiers (16 types are listed in a table). A test run on a Wellman-Galusha gasifier has been made to validate a one-dimensional code.

**33554** (DOE/METC–89/6105, pp. 226-238) **METC's on-site gasification/cleanup program.** Wieber, P.R. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

This paper describes the role and activities of the Morgantown Energy Technology Center (METC) in-house research on coal gasification and hot gas cleanup. Past activities are recalled and current and future facilities described that may assist the development of fuel cells fed by coal gas. The Technology Transfer Act is discussed. It allows cooperative projects between the private sector and METC to be performed on-site.

**33555** (DOE/METC–89/6105, pp. 346-349) **Sorbent characterization in relation to hot gas cleanup.** Cook, J.M.; Siriwardane, R.V. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The overall objective of this project is to develop both an understanding of and the ability to predict the behavior of sulfur-bearing gases with solid sorbents primarily in gasification processes. These predictive capabilities will then be applied directly to the removal of hydrogen sulfide ($H_2S$) by zinc titanate or other similar compounds, as well as the removal of sulfur dioxide ($SO_2$) by hydrated lime, limestone, or other similar sorbent material. The secondary objectives are to: (1) determine the mechanisms by which sorbents capture sulfur, (2) determine the mechanisms by which sorbent regeneration occurs, (3) determine the effect of impurities on both sets of mechanisms, (4) determine the diffusion rate of the sulfur-bearing as through the product layer that forms on the surface of the sorbent, and (5) determine a formulation of gaseous, pore diffusion in the sorbent. At the present time, sorption reaction rates are backed out of experimental data based upon assumptions contained in the model. By assembling the above information, a reaction rate should be empirically determinable for the reactions of any given sorbent with a sulfur-bearing gas; this assumes that the properties of the gas and the sorbent are known. The appropriate combination of the chemical reaction rate, the product layer diffusion, and the pore diffusion should allow an improved level of accuracy in the predictions of sorbent utilization, pore plugging, etc.

**33556** (DOE/METC–89/6105, pp. 350) **METC in-house cleanup research.** Gansley, R.R. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The objective of METC's in-house cleanup research is to develop and evaluate processes for removing hydrogen sulfide and other contaminants from hot gasifier fuel gas streams. Clean gas is then delivered to downstream power generating units, such as a gas turbine or a molten carbonate fuel cell. Previous work has shown that a fixed bed of zinc ferrite is capable of removing hydrogen sulfide to levels of less than 10 ppm at temperatures of 1,000 to 1,200F. Current research activities include the testing of new sorbents such as zinc titanate, development of a fluid bed desulfurization process, and testing of sorbents to determine the long term effects of other contaminants such as hydrogen chloride. The research facilities include a 2-inch diameter lab-scale reactor system which has been operating for five years, a newly modified reactor system with both a 3-inch fluid bed reactor and a 6-inch fixed bed reactor capable of operating at 300 psig, and a new reactor system with two 6-inch cleanup vessels which can operate at 300 psig. These later two reactor systems use gas delivered from METC's fluid bed gasifier; the lab-scale reactor uses simulated coal gas. A fourth reactor system with a 2-inch diameter reactor capable of operating at 600 psig is under construction. Recent fluid bed testing with zinc ferrite in the lab-scale reactor has shown positive results. However, it is anticipated that a two-stage fluid bed process will be necessary to remove hydrogen sulfide to the desired levels. Future research plans are to continue to test novel sorbents and process concepts, continue development of a fluid bed process including testing in a semi-continuous mode, and to investigate the effect of pressure on both fixed and fluid bed absorption processes. The text of the presentation is not included.

33557 (DOE/PC/70768–9) **Kinetics of coal pyrolysis and devolatilization: Technical progress report, January 1, 1987–March 31, 1987.** United Technologies Corp., East Hartford, CT (United States). Research Center. [1987]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70768. Order Number DE92000204. Source: OSTI; NTIS; GPO Dep.

The objective of these experimental and modeling studies is to develop an improved understanding of the kinetics of coal devolatilization which is relevant to suspension firing of powdered coal. These fundamental kinetic studies address several topics related to pulverized coal combustion and include both homogeneous and heterogeneous reactions. The principal topics include: (1) the pyrolysis and devolatilization of coal; and (2) the formation of char. Research activities include small-scale experimentation, interpretation of experimental results in terms of mechanistic understanding and the development and validation of kinetic models of fundamental processes. This report consists of two contributions. The first is from MIT entitled "Intra-Particle Heat Transfer Effects in Coal Pyrolysis". While this modeling study bears some similarity to the Ohio State work, it is proposed as the starting point for a more complete model which will include other boundary conditions as well as mass transfer effects. The second contribution is a report from UTRC entitled "Effect of Heat Transfer on Tar and Light Gases From Coal Pyrolysis". This work documents some of the changes in the chemical composition of the products of pyrolysis when the mode or rate of heat transfer is varied. 28 refs., 17 figs., 3 tabs.

33558 (DOE/PC/79886–T1) **Halogen treatment of char for the removal of sulfur and mineral matter: Final report, June 24, 1987–September 23, 1990.** Im, C.J.; Durney, T.; Matuszak, M. Coal Technology Corp., Bristol, VA (United States). Jul 1991. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79886. Order Number DE91017023. Source: OSTI; NTIS; GPO Dep.

The overall purpose oft his project was to investigate the fundamentals of high temperature halogenation for the purification of coal char, a by-product of mild coal gasification. The objective of this review is to present the results of a literature search designed to gather information concerning carbon purification as it applies to coal char. The information gathered from the literature survey, selected commercial producers, and results of preliminary experimental testing were used to determine the preliminary economic and technical feasibility of coal char purification by high temperature halogenation techniques. The literature review served a dual purpose of determining the feasibility of the process and aid in the design of a bench-scale experimental reactor. A bench-scale test apparatus was used by Coal Technology Corporation (CTC) to conduct experiments investigating the effects of temperature, residence time, pressure, feedstock characteristics (size distribution and source), gas flowrate, and type of halogen gas (chlorine or fluorine) as it related to the removal of sulfur and mineral matter from coal char. 21 refs., 15 figs., 27 tabs.

33559 (DOE/PC/79921–T10) **Pore structure and reactivity changes in hot coal gas desulfurization sorbents: Technical progress report, October–December 1990.** Sotirchos, S.V. Rochester Univ., NY (United States). Dept. of Chemical Engineering. Jan 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-87PC79921. Order Number DE91013896. Source: OSTI; NTIS; GPO Dep.

The primary objective of the project is the investigation of the structural and reactivity changes occurring in metal/metal oxide sorbents used for desulfurization of hot coal gas during sulfidation and regeneration, with particular emphasis placed on the effects of these changes on the sorptive capacity and efficiency of the sorbents. The following tasks have been identified in the project: conversion vs. time studies during sulfidation and regeneration; pore structure evolution studies during sulfidation and regeneration; intraparticle diffusion studies; development of structural models for hot coal gas desulfurization sorbents; and development of mathematical models for fixed-bed desulfurization reactors. During the fourth quarter of the 1990 calendar year, our research efforts primarily focused on Task 3. A summary of the work done follows. The pulse chromatographic apparatus that was described in the Technical Progress Report for July–September 1990 was used to measure effective diffusivities in partially reacted samples of calcium or zinc oxide sorbents. We also developed a novel algorithm that can be used to solve mathematical models for fixed-bed reactors and used it to estimate effective diffusion coefficients from the pulse chromatographic data we obtained for partially, nonuniformly reacted sorbents. Our algorithm, which can be used for sulfidation and regeneration models of fixed-bed desulfurization reactions, takes advantage of the special structure of the mathematical model to achieve a dramatic reduction in the computational time needed for the solution of the model equations.

33560 (DOE/PC/79930–T6) **Pyrolysis and gasification of coal at high temperatures: Fourteenth quarterly progress report, December 15, 1990–March 15, 1991.** Zygourakis, K. Rice Univ., Houston, TX (United States). Dept. of Chemical Engineering. [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-87PC79930. Order Number DE91018325. Source: OSTI; NTIS; GPO Dep.

Research continued on pyrolysis and gasification of coal. Tasks include: Effects of pyrolysis conditions on macropore structure. Coals of different ranks will be pyrolyzed in a microscope hot-stage reactor using inert and reacting atmospheres. The macropore structure of the produced chars will be characterized using video microscopy and digital image processing techniques to obtain pore size distributions. Comparative studies will quantify the effect of pyrolysis conditions (heating rates, final heat treatment temperatures, particle size and inert or reacting atmosphere) on the pore structure of the devolatilized chars; gasification under strong intraparticle diffusional limitations. The devolatilized chars will be gasified in the regime of strong intraparticle diffusional limitations using $O_2/N_2$ and $O_2/H_2O/N_2$ mixtures. Constant temperature and programmed-temperature experiments in a TGA will be used for these studies. Additional gasification experiments performed in the hot-stage reactor will be videotaped and selected images will be analyzed to obtain quantitative data on particle shrinkage and fragmentation; and mathematical modeling and model validation. 6 figs.

33561 (DOE/PC/79938–T6) **Studies of coupled chemical and catalytic coal conversion methods: Fifteenth quarterly report for July 1991.** Stock, L.M. Chicago Univ., IL (United States). Dept. of Chemistry. [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79938. Order Number DE92000333. Source: OSTI; NTIS; GPO Dep.

When an arene is coordinated to $Cr(CO)_3$, profound changes in its reactivity occur. Ring and benzylic hydrogen atoms exhibit enhanced acidity, and typical arene reactions such as electrophilic aromatic substitutions are quenched. In contrast, the ring carbon atoms are activated toward attack by nucleophiles. These changes in reactivity are manifestations of the forceful electron withdrawing nature of the $Cr(CO)_3$ component, and of the ability of this group to stabilize charged intermediates. In addition, arenechromium tricarbonyl complexes have been proven to be good catalysts in the hydrogenation of dienes. While most simple complexes such as toluenechromium tricarbonyl require the use of high temperatures and dihydrogen pressures, arenechromium tricarbonyl complexes with napthalene, anthracene, and phenanthrene show remarkable activity under extremely mild conditions. An investigation has been under way in which the chemistry of coal arene-$Cr(CO)_3$ complexes have been studied. 4 figs.

33562 (DOE/PC/88922–12) **Supercritical fluid thermodynamics for coal processing: Quarterly progress report, April 1, 1991–June 30, 1991.** van Swol, F. (Illinois Univ., Urbana, IL (United States). Dept. of Chemical Engineering); Eckert, C.A. Illinois Univ., Urbana, IL (United States). Dept. of Chemical Engineering; Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemical Engineering. [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88922. Order Number DE91018629. Source: OSTI; NTIS; GPO Dep.

Because of their unusual solvating and mass transfer properties, supercritical fluids show potential for a variety of coal processing applications. We have established a database of coal model compound equilibria; to add to this database, we have developed and are testing techniques of measuring cosolvent effects on solubility rapidly. In addition, we have used fluorescence spectroscopy to

study the nature of cosolvent effects on a molecular level. The solubility and spectroscopic measurements are being used in the development of an equation of state that includes both physical and chemical interactions; we are currently testing the equation. The equation of state will be used to predict solubility behavior so systems can be designed for the processing of coal with supercritical fluids. 6 refs., 4 figs.

**33563** (DOE/PC/88933–10) **Alkali/$TX_2$ catalysts for $CO/H_2$ conversion to $C_1$–$C_4$ alcohols: Technical progress report, March–May 1991.** Klier, K.; Herman, R.G.; Richards, M. Lehigh Univ., Bethlehem, PA (United States). Jun 1991. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88933. Order Number DE91018163. Source: OSTI; NTIS; GPO Dep.

The $Cs/RuS_2$ sample prepared previously, was catalytically tested under a reactant gas mixture of $CO/H_2 \sim 1$. The activity of this catalyst was comparable to that of an undoped sample of $RuS_2$. This sample was also examined by HR-ESCA to determine whether the Cs dopant actually was present on the surface, and analysis by HR-ESCA showed a significant quantity of Cs on the $RuS_2$ surface. The third angle-resolved ESCA study of the $MoS_2$ single crystal has been carried out. In this study, the crystal was held at fixed polar angles of 48° and 64° and the azimuthal space was incremented by 10° from 0° to 360°. Both the Al $K_\alpha$ and conventional Mg $K_\alpha$ anodes were used. The regions obtained were the Mo $3d_{5/2}$ and S 2p for the Al $K_\alpha$ anode and the Mo 3d and S 2p for the Mg$K_\alpha$ anode. The purpose of this study was to prove that the peak at 48° in the intensity of diffracted photoelectons vs polar angle (at an azimuthal angle of ~50°) occurs at three azimuthal directions corresponding to the Mo-S bond directions as described previously.

**33564** (DOE/PC/89759–T7) **Investigation of the rank dependence of tar evolution: Quarterly report, January 1, 1991–March 31, 1991.** Freihaut, J.D.; Proscia, W.M. United Technologies Research Center, East Hartford, CT (United States). [1991]. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89759. Order Number DE91018338. Source: OSTI; NTIS; GPO Dep.

Heated grid experiments have been conducted to test the crosslinking hypothesis which has been advanced by some investigators to explain the observed differences in tar yields with coal type. Three coals were studied: two HVA bituminous coals and a subbituminous coal. Results indicate, for the HVA coals, that crosslinking is unimportant relative to predicting total volatiles yield under rapid heating conditions. Results for the subbituminous coal are inconclusive. Devolatilization models which use functional group or aromatic bridge site concentrations in the parent coal as source terms for crosslinking sites are not justified. Models which incorporate the influence of differences in parent coal structure on tar precursor chemical and physical properties are more likely to be successful in predicting tar evolution behavior over a range of coal ranks. The molecular weight distributions (MWDs) of tars evolved from a range of coal ranks in the heated grid have been determined using an improved size exclusion chromatography (SEC) technique. Previous investigations have shown that tar yields, chemical and physical characteristics, and particle morphology are observed to vary significantly with ambient pressure, indicating interphase mass transfer has a significant effect on the tar evolution process with respect to product composition. The objective of one task was to quantify the effect of mass transfer resistance alone, as a function of extent of reaction and coal type. Towards this end, a heated grid experiment was devised which delivered equivalent heating fluxes in both vacuum and ambient pressure conditions. Three HVA bituminous coals were investigated (PSOC 1499d, 1451D and 1493D). ZHT heated grid runs were conducted in vacuum and 1 atm. argon to three final temperatures: 550, 650 and 750 C. 10 refs., 12 figs., 5 tabs.

**33565** (DOE/PC/89771–7) **Mechanism of hydrodenitrogenation low temperature oxygen chemisorption over acidic molybdenum catalysts: Part 7: Seventh quarter report, April 1–June 30, 1991.** Miranda, R. Louisville Univ., KY (United States). Dept. of Chemical Engineering. [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89771. Order Number DE91018331. Source: OSTI; NTIS; GPO Dep.

The low temperature oxygen chemisorption over acidic molybdena catalysts has evidenced the strong reducibility of near-surface Mo, and the effect of catalyst loading and support composition on such reducibility. It was determined that for supports with compositions under 50% silica, the optimum loading producing maximum surface reducibility is 8 wt% $MoO_3$, while for supports with more than 50% silica, the optimum loading is 4 wt% $MoO_3$. At this loading, a substantial portion of the support (containing acidic sites) is also exposed. The role of Lewis sites produced on the molybdena surface by coordinative unsaturation is the strong adsorption of aromatic or unsaturated amines, and the destabilization of C-C and C-N bonds. Hydrogenation and hydrogenolysis can then occur by H addition. The highly acidic Bronsted sites, present on the support as well as on the molybdena, strongly chemisorb the hydrogenated amines. The acidic sites contribute to denitrogenation by Hofmann elimination mechanism, as shown by the the abundance of unsaturated hydrocarbons produced, and are also active for cracking and cyclization, as shown by the selectivity towards methane and cyclopentene. 13 refs., 3 figs., 1 tab.

**33566** (DOE/PC/89773–5) **Coal plasticity at high heating rates and temperatures: Fifth technical progress report.** Gerjarusak, S.; Peters, W.A.; Howard, J.B. Massachusetts Inst. of Tech., Cambridge, MA (United States). Aug 1991. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89773. (FE-MIT–89773-5). Order Number DE92000310. Source: OSTI; NTIS; GPO Dep.

This report presents the Ph.D. Thesis Proposal of Mr. Sarakorn Gerjarusak to the MIT Department of Chemical Engineering on the topic: "Plasticity Kinetics of Different Coal Types." A theoretical approach to the study of coal plasticity is described. Previous work relating the viscosity of molten coal to the inventory of metaplast employed a single chemical reaction model. In order to be able to use the kinetics parameters such as the activation energy obtained at one temperature-time history to predict the plasticity of molten coal at other temperature-time histories, a multiple independent parallel reaction model will be used to interpret our plastometer data. In addition, key plastic properties of different coals such as maximum fluidity and duration of plasticity will be correlated to a coal-type specific parameter formulated by Ko, and requiring only the elemental composition of the parent coal. Finally, the plastic properties of each coal will be correlated to the tar yield from that coal to test a model which assumes metaplast to be the precursor of tar. 24 refs., 8 figs., 1 tab.

**33567** (DOE/PC/89773–6) **Coal plasticity at high heating rates and temperatures: Sixth technical progress report.** Gerjarusak, S.; Peters, W.A.; Howard, J.B. Massachusetts Inst. of Tech., Cambridge, MA (United States). Sep 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89773. (FE-MIT–89773-6). Order Number DE91018611. Source: OSTI; NTIS; GPO Dep.

Three high-volatile bituminous coals: Pittsburgh No. 8, Illinois No. 6, and Blue were studied using the plastometer at vacuum and 1 atm. The maximum fluidity and plastic period of each coal correlates strongly with its maximum tar yields. In addition, the experimental pressure also affects the plastic period and maximum fluidity of each coal. The plastic period of each coal is shorter at vacuum than 1 atm, apparently because vacuum facilitates transport of metaplast from the coal melt, forming tar and reducing plasticity. The maximum fluidity of each coal is greater at vacuum than 1 atm because the metaplast inventory (estimated by the amount of pyridine extractables) during pyrolysis is higher at vacuum than 1 atm. 8 refs., 3 figs., 2 tabs

**33568** (DOE/PC/89775–5) **Control of catalytic hydrotreating selectivity with ammonia: [Quarterly] report, April 1, 1991–June 30, 1991.** Satterfield, C.N.; Lee, Chung M. Massachusetts Inst. of Tech., Cambridge, MA (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89775. Order Number DE91018084. Source: OSTI; NTIS; GPO Dep.

Research continued on the control of catalytic hydrotreating selectivity with ammonia. Progress is discussed on the effect of

ammonia on the hydrodenitrogenation of quinoline and the hydrogenation of tetralin, naphthalene, and butylbenzene. Results are discussed in terms of competitive adsorption. 8 refs., 13 figs., 2 tabs. (CBS)

**33569** (DOE/PC/89793–T4) **Undergraduate research studies program at participating institutions of the HBCU Fossil Energy Consortium: Quarterly report on the Atlanta University Center, Inc. Component, April 1, 1990–June 30, 1990.** Bhatia, S.C. (Atlanta Univ. Center, Inc., GA (United States). Dolphus E. Milligan Science Research Inst.); Cardelino, B.H.; Hall, J.H. Jr.; Mitchell, M.B.; Stelson, A.W. Clark Atlanta Univ., GA (United States). 31 Jul 1990. 11p. Sponsored by USDOE. Washington, DC (United States). DOE Contract FG22-89PC89793. Order Number DE91017171. Source: OSTI; NTIS; GPO Dep.

The objectives of this research program are to expose students in minority institutions of energy and fossil fuels research, to stimulate their interest in the sciences and engineering, and to encourage them to pursue graduate studies, thereby ensuring the necessary supply of manpower for the industrial and energy sectors of the national economy. Two projects are discussed here. The first is focused on the surface chemical properties of coal and their influence on the adsorption of aqueous soluble catalyst metals. The objective of the second project is to characterize coal derived liquids for distribution of oxygen, nitrogen and sulfur heteroatoms relative to the average molecular weight distribution of the coal liquid. The technique of size exclusion chromatography will be used. 2 refs., 2 figs.

**33570** (DOE/PC/89876–T3) **Biological production of ethanol from coal, March 22, 1991–June 21, 1991.** Arkansas Univ., Fayetteville, AR (United States). Dept. of Chemical Engineering. [1991]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89876. (PETC–2-3-91). Order Number DE91018626. Source: OSTI; NTIS; GPO Dep.

Research continued on the bioconversion of CO, $CO_2$ and $H_2$ to ethanol and acetates. Carbon balances on previous batch fermentation results show that 89 mol percent of the carbon in CO is converted to products (ethanol, acetate and $CO_2$), with the balance directed toward cell production and maintenance. Continuous fermentation results in the CSTR studying the effects of liquid flow rate and agitation rate on cell and product formation indicate that the CSTR should be operated at high agitation rates and low liquid flow rates to achieve high cell and ethanol concentrations, and favorable product yields. At a liquid flow rate of 100 mL/d and an agitation rate of 400 rpm, an ethanol concentration of 2.5 g/L and an acetate concentration of 1.5 g/L was attained. Finally, cell recycle is being studied as a method of increasing cell concentration, ethanol concentration and product ratios. Preliminary results show an ethanol concentration of over 6 g/L in the CSTR with cell recycle, and a product ratio of 100 g ethanol/g acetate. 1 ref., 15 figs., 2 tabs.

**33571** (DOE/PC/89883–23) **Coal liquefaction process streams characterization and evaluation: Quarterly Technical progress report, July 1–September 30, 1990.** Brandes, S.D.; Robbins, G.A.; Winschel, R.A.; Burke, F.P. Consolidation Coal Co., Library, PA (United States). Research and Development Dept. Jun 1991. 119p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89883. Order Number DE91018668. Source: OSTI; NTIS; GPO Dep.

Four major topics are reported here. The first topic is the analysis and interpretation of samples provided by Hydrocarbon Research, Inc. from four runs. The first two runs used Black Thunder Mine Coal; the latter two used Burning Star No. 2 coal. The first run tested the effects of increased first-stage reactor volume. The second run explored thermal pretreatment of the coal slurry (for deoxygenation and drying) and the addition of $H_2S$ during liquefaction. The last two runs tested the effects of coal cleaning technologies (oil agglomeration and the OTISCA Industries process) on liquefaction performance. The second topic is the chemical and petrographic analysis of three Illinois coals which are candidates for use at the Wilsonville facility. The third topic is the status of the Participants Program. Last, the slides for a short course presented at the Seventh Annual International Pittsburgh Coal Conference are appended.

**33572** (DOE/PC/90029–T1) **Cooperative research program in coal liquefaction: Quarterly report, May 1, 1990–July 31, 1990.** Huffman, G.P.; Sendlein, L.V.A. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). [1990]. 120p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC90029. Order Number DE91013954. Source: OSTI; NTIS; GPO Dep.

Cooperative research in coal liquefaction is presented. Topics include: Sulfate-promoted metal oxides as direct coal liquefaction catalysts; low temperature depolymerization and liquefaction of premium US coal samples; construction of continuous flow-through gas reactor for liquefaction investigations; examination of ferric sulfide as a liquefaction catalyst; generic structural characterization and liquefaction research; spectroscopic studies of coal macerals depolymerization catalyzed by iron chloride; characterization of catalysts used in coal hydrogenation systems; coal structure/liquefaction yield correlation by means of advanced NMR techniques; mass spectrometry of coal derived liquids: determination of molecular weight distributions; catalyst cracking, hydrogenation and liquefaction of coals under milder conditions; ENDOR investigations of coal liquefaction under mild conditions; direct determination of hydroaromatic structures in coal and coal conversion products by catalytic dehydrogenation; surface characterization of APCSB coals by XPS; computation chemistry of model compounds and molecular fragments of relevance to coal liquefaction; chemical characterization and hydrogenation reactions of single coal particles; the role of hydrogen during liquefaction using donor and non-donor solvents; solvent sorption and FTIR studies on the effect of catalytic depolymerization reactions in coal; bioprocessing of coal; chemical routes to breaking bonds: new approaches to low-temperature liquefaction; an investigation into the reactivity of isotetralin and tetralin using molecular orbital calculations; coal liquefaction modification for enhanced reactivity; catalytic hydropyrolysis and energized extraction of coals; gallium catalyst in mild coal liquefaction – potential of temperature microscope in coal liquefaction; evaluation of nitride catalysts for hydrotreatment and coal liquefaction; and improved catalysts for coal liquefaction and coprocessing.

**33573** (DOE/PC/90029–T3) **Cooperative research program in coal liquefaction: Quarterly report, November 1, 1990–January 31, 1991.** Huffman, G.P.; Sendlein, L.V.A. Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States). [1991]. 162p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC90029. Order Number DE91018341. Source: OSTI; NTIS; GPO Dep.

This report is a coordinated effort of the Consortium for Fossil Fuel Liquefaction Science. The topics concerning coal liquefaction discussed are: sulfate promoted metal oxides as direct coal liquefaction catalysts; low temperature depolymerization and liquefaction of premium R.S. coal samples; construction of continuous flow-through gas reactor for liquefaction investigations; generic structural characterization and liquefaction research; macerals, model compounds and iron catalyst dispersion; coal structure/liquefaction yield correlation by means of advanced NMR techniques; GC/MS of model compound mixtures; catalytic cracking, hydrogenation and liquefaction of coals under milder conditions; ENDOR investigations of coal liquefaction under mild conditions; catalytic dehydrogenation of model compounds in relation to direct coal liquefaction; surface characterization of catalyst added coal samples; computational chemistry of model compounds and molecular fragments of relevance to coal liquefaction; chemical characterization and hydrogenation reactions of single coal particles; thermolytic cleavage of selected coal-related linkages at mild temperatures; solvent sorption and FTIR studies on the effect of catalytic depolymerization reactions in coal; bioprocessing of coal; chemical routes to breaking bonds; novel liquefaction concepts cyclic olefins: novel new donors for coal liquefaction; better hydrogen transfer in coal liquefaction; catalytic hydropyrolysis and energized extraction of coals; gallium catalyst in mild coal liquefaction; potential of temperature microscope in coal liquefaction; evaluation of nitride catalysts for hydrotreatment and coal liquefaction; coprocessing and coal liquefaction with novel catalysts.

**33574** (DOE/PC/90048–T1) **Fine particle clay catalysts for coal liquefaction: Quarterly technical report, February 8, 1991–May 8, 1991.** Olson, E.S. Universal Fuel Development Associates, Inc., Grand Forks, ND (United States). [1991]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90048. Order Number DE92000446. Source: OSTI; NTIS; GPO Dep.

The efficient production of environmentally acceptable distillate fuels requires catalysts for hydrogenation and cleavage of the coal macromolecules and removal of oxygen, nitrogen, and sulfur heteroatoms. The goal of the proposed research is to develop new catalysts for the direct liquefaction of coal. This type of catalyst consists of fine clay particles that have been treated with reagents which form pillaring structures between the aluminosilicate layers of the clay. The pillars not only hold the layers apart but also constitute the active catalytic sites for hydrogenation of the coal and solvent used in the liquefaction. The pillaring catalytic sites are composed of pyrrhotite, which has been previously demonstrated to be active for coal liquefaction. The pyrrhotite sites are generated in situ by sulfiding the corresponding oxyiron species. The size of the catalyst will be less than 40 nm in order to promote intimate contact with the coal material. Since the clays and reagents for pillaring and activating the clays are inexpensive, the catalysts can be discarded after use, rather than regenerated by a costly process. The proposed work will evaluate methods for preparing the fine particle iron-pillared clay dispersions and for activating the particles to generate the catalysts. Characterization studies of the pillared clays and activated catalysts will performed. The effectiveness of the pillared clay dispersion for hydrogenation and coal liquefaction will be determined in several types of testing. 5 refs., 1 tab.

**33575** (DOE/PC/90176–T42) **Chemical coal cleaning using selective oxidation: Technical report, March 1, 1991–May 31, 1991.** Palmer, S.T. (Southern Illinois Univ., Carbondale, IL (United States). Dept. of Geology); Hippo, E.J. Southern Illinois Univ., Carbondale, IL (United States). Dept. of Geology. [1991]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90176. Order Number DE91018306. Source: OSTI; NTIS; GPO Dep.

This project investigates the removal of sulfur from coal using selective oxidation. All preparation and analysis of the IBCSP coals is complete. During this quarter desulfurization studies have been performed in which particle size, reaction time and reaction temperature parameters were varied. Results obtained to data support the following preliminary conclusions: (1) No improvement in desulfurization was achieved by grinding to very small particle sizes. (2) The sulfur contents of IBC 101 and 106 samples can be reduced by 40% and 50% respectively at room temperature, by 54% and 63% at 50°C and by 69% and 71% at 104°C. (3) Although sulfur contents are reduced at higher temperatures the yield of solid coal is also reduced and hence the potential as a desulfurization process is diminished. (4) Nearly 80% of the total sulfur can be removed from both the 101 and 106 coals but about 30% of the weight of the coal dissolves. Similarly at 10% coal weight loss about 60% of the sulfur in the IBC 106 coal and about 40% of the sulfur in the IBC 101 coal can be removed using the peroxyacetic acid procedure. (5) Although most of the sulfur removal can be attributed to pyrite removal, some organic sulfur removal has been observed. (6) Peroxyacetic acid can be used to improve the ash contents of the coals. (7) The peroxyacetic acid oxidation of coal may be an alternative method for the determination of organic sulfur contents. (8) Selective oxidation also shows potential as a pretreatment step for the removal of even more organic sulfur. One product derived from the IBC 101 coal using this approach had a sulfur content of the only 0.98%, a sulfur reduction of nearly 80%. 8 figs.

**33576** (DOE/PC/90288–T1) **Kinetics of supercritical fluid extraction of bituminous coal with tert-butanol: [Technical progress report, May–July 1991].** Zhang, Chunjie; Smith, J.M.; McCoy, B.J. California Univ., Davis, CA (United States). Dept. of Chemical Engineering. [1991]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90288. Order Number DE91018736. Source: OSTI; NTIS; GPO Dep.

This paper presents a simplified kinetics study of supercritical tert-butanol extraction of Illinois No. 6 bituminous coal. Extraction rates were estimated by continuously measuring the spectrophotometric absorbance (at 235 nm) of the effluent from a fixed-bed flow reactor. The experiments were conducted in the temperature range of 553–633 K and at 6.8 MPa constant pressure by programmed-temperature techniques. A model for which the extractable material is represented by two groups of components, undergoing parallel first-order reactions, satisfactorily describes the experimental data. The kinetics data indicate that the first group is extracted by a physical process which occurs below 573 K. The second group is extracted via a thermal decomposition reaction (with an apparent, average activation energy of 54 kJ/gmol) which is dominant above 573 K. Total fractions extracted were low ($\leq$ 8 wt. %) at the temperature and pressure employed. 21 refs., 10 figs., 3 tabs.

**33577** (DOE/PC/90289–T2) **Mild coal pretreatment to improve liquefaction reactivity: Quarterly technical progress report, March–May 1991.** Miller, R.L. Colorado School of Mines, Golden, CO (United States). Dept. of Chemical Engineering and Petroleum Refining. [1991]. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90289. Order Number DE91018664. Source: OSTI; NTIS; GPO Dep.

This report describes work on effects of mild chemical pretreatment on coal dissolution reactivity during low severity liquefaction or coal/oil coprocessing. The overall objective is to elucidate changes in the chemical and physical structure of coal by pretreating with methanol or other simple organic solvent (hexane or acetone) and a trace amount of hydrochloric acid and measure the influence of these changes on coal dissolution reactivity. This work is part of a larger effort to develop a new coal liquefaction or coal/oil coprocessing scheme consisting of three main process steps: (1) mild pretreatment of the feed coal to enhance dissolution reactivity and dry the coal, (2) low severity thermal dissolution of the pretreated coal to obtain a very reactive coal-derived residual material amenable to upgrading, and (3) catalytic upgrading of the residual products to distillate liquids. Progress is discussed. 51 refs., 8 figs., 3 tabs.

**33578** (DOE/PC/90293–4) **High temperature membranes for $H_2S$ and $SO_2$ separations: Quarterly progress report, March 1, 1991–June 30, 1991.** Winnick, J. Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemical Engineering. [1991]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90293. Order Number DE91018670. Source: OSTI; NTIS; GPO Dep.

High temperature membrane separation techniques have been applied to gas mixtures involved in coal utilization. For coal gasification, $H_2S$ has been removed from the syn-gas stream, split into hydrogen, which enriches the syn-gas, and sulfur, which can be condensed from an inert gas sweep stream. For coal combustion, $SO_2$ has been separated from the flue gas, with concentrated $SO_3$ produced as a by-product. Both processes appear economically viable but each requires fundamental improvements: both the $H_2S$ cell needs a more efficient anode. Membranes will be fabricated by either hot-pressing, impregnation of sintered bodies or tape casting. Work during the quarter concentrated on a final determination of suitability for the commercial Ni electrodes oxidized in situ and several full cell tests using different electrodes and ceramic loading in the membranes. Full cell tests showed the ERC electrodes to flood, impeding removal rates. These electrodes have since been discarded for a different commercially available electrode (National Standard Fibrex mesh). 8 figs.

**33579** (DOE/PC/90302–T2) **Equilibrium and volumetric data and model development of coal fluids, January 15, 1991–April 15, 1991.** Robinson, R.L. Jr.; Gasem, K.A.M. Oklahoma State Univ., Stillwater, OK (United States). School of Chemical Engineering. 27 May 1991. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90302. Order Number DE91018327. Source: OSTI; NTIS; GPO Dep.

Research on phase studies of mixtures and coal fluids continued. During the present reporting period, the solubility of methane in n-hexane was measured at temperatures from 310.9 to 377.6 K (100 to 220°F) and pressures to 85 bars (1235 psia). These data are described with root mean square (RMS) errors within 0.0033 in mole fraction by the Soave-Redlich-Kwong (SRK) and Peng-Robinson (PR) EOS when one interaction parameter, $C_{ij}$, is used

over the complete temperature range. The present data are in good agreement with the earlier measurements of Poston and McKetta, and Shim; in general, deviations no larger than 0.003 in mole fraction are observed. 16 refs., 4 figs., 3 tabs.

**33580** (DOE/PC/90305–T3) **Probe molecule studies: Active species in alcohol synthesis: Third quarterly report, April 1991–June 1991.** Blackmond, D.G.; Wender, I. Pittsburgh Univ., PA (United States). Dept. of Chemical and Petroleum Engineering. Jul 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90305. Order Number DE92000332. Source: OSTI; NTIS; GPO Dep.

The goal of this research is to develop a better understanding of the mechanisms of formation of alcohols and other oxygenates from syngas over supported catalysts. Different probe molecules are planned to add in situ during the reaction to help delineate reaction path ways and identify reaction intermediate species. The key of our study is to investigate how the species generated by these probe molecules interact with surface species present during oxygenate formation. CO hydrogenation reactions are being carried out in both the presence and the absence of the probe molecule under conditions which favor the formation of oxygenated products. A reaction and analysis system capable of carrying out the experiments for this study has been set up, modified, and tested. First, the commercially important Cu/ZnO/Al203 catalyst for methanol synthesis is being studied. Other catalysts, such as Pd and Rh with and without alkali or oxide promoters which are known to produce oxygenates from syngas, are being prepared and characterized for this study. Based on the observation of a previous study that nitromethane is an effective source of CH2 groups, it will be one of the primary probe molecules to be studied. In addition, acetylenic compounds are primary choices for this study also. These compounds were found by other workers to be effective as a source of chain initiators. 2 figs.

**33581** (DOE/PC/90307–2) **Reactivity of young chars via energetic distribution measurements: Quarterly technical progress report, December 15, 1990–March 15, 1991.** Calo, M.M.; Snyder, B.; Rachel, W.G.; Lilly, W.D. Brown Univ., Providence, RI (United States). Div. of Engineering. [1991]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90307. Order Number DE91018330. Source: OSTI; NTIS; GPO Dep.

The current project is directed at developing related techniques for the characterization and prediction/correlation of the reactivity of "young" chars to steam and oxygen. Of particular interest is mapping of the reactivity behavior of the resultant chars, as revealed by the energetic heterogeneity of the complexes with char preparation conditions; i.e., heating rate and ultimate temperature. In this second quarterly technical progress report on this grant, we present some preliminary work performed on the effect of oxidant partial pressure and diluent gases on gasification rates. Oxygen gasification experiments of resin char at 723K were conducted using 20% oxygen in helium and argon as the diluent gases. At 6% burn-off the resultant gasification rates were 0.00346 g/g-h in helium, and 0. 00926 g/g-h in argon – an enhancement of almost a factor of three in argon over helium. Thus, the effect observed by Walker et al. (1977) has now been seen in our own laboratory at higher total pressures (i.e., one atmosphere). $CO_2$ gasification experiments were conducted on Wyodak coal char and resin char samples as a function of $CO_2$ partial pressure. Resultant global reaction orders and activation energies are reported. TPD spectra will be obtained from these samples in order to improve the understanding of the effect of reduced partial pressure on gasification rates. 29 refs., 11 figs., 2 tabs.

**33582** (DOE/PC/90312–T3) **Hot gas desulfurization with sorbents containing oxides of zinc, iron, vanadium and copper: Quarterly technical progress report.** Akyurtlu, A.; Akyurtlu, J.F. Hampton Univ., VA (United States). Dept. of Engineering. Jul 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90312. Order Number DE91018614. Source: OSTI; NTIS; GPO Dep.

The main objective of this research is to evaluate the desulfurization performance of novel sorbents consisting of different combinations of zinc, iron, vanadium and copper oxides: and to develop a sorbent which can reduce $H_2S$ levels to less than 1 ppmv, which can stabilize zinc, making operations above 650°C possible, and which can produce economically recoverable amounts of elemental sulfur during regeneration. This objective will be accomplished by evaluating the sorbent performance using fixed-bed and thermal gravimetric analysis experiments supported by sorbent characterization at various reaction extents. Work done in this quarter includes: (a) construction of the experimental setup, (b) preparation of test sorbents, and (c) characterization of the prepared sorbents. The construction of the setup was completed. The setup was leak tested. The rotameters were calibrated. The installation of software and hardware on the gas chromatograph was completed. Currently calibration runs with a 8.64 ppmv $H_2S$-$N_2$ mixture are being conducted. Eight test sorbents of zinc ferrite containing 1, 2, 4.8, or 15 mass per cent vanadium and calcined at 600°C or 750°C were prepared. These samples were analyzed by atomic absorption to determine their actual composition. Physical characterization of these sorbents are under way.

**33583** (DOE/PC/91026–T1) **The dual role of oxygen functions in coal pretreatment and liquefaction: Crosslinking and cleavage reactions: First quarterly report, April 2, 1991–June 30, 1991.** Serio, M.A.; Kroo, E.; Teng, Hsisheng; Charpenay, S.; Solomon, P.R. Advanced Fuel Research, Inc., East Hartford, CT (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC91026. Order Number DE91018739. Source: OSTI; NTIS; GPO Dep.

The overall objective of this project is to elucidate and model the dual role of oxygen functions in thermal pretreatment and liquefaction of low rank coals through the application of analytical techniques and theoretical models. The project will be an integrated study of model polymers representative of coal structures, raw coals of primarily low rank, and selectively modified coals in order to provide specific information relevant to the reactions of real coals. The investigations will include liquefaction experiments in microautoclave reactors along with extensive analysis of intermediate solid, liquid and gaseous products. Attempts will be made to incorporate the results of experiments on the different systems into a liquefaction model.

**33584** (EGG-M–90355) **Oxygen transfer problems in coal processing bioreactors.** Andrews, G.; Stevens, C.J.; Quintana, J.; Dugan, P.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1990]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-900958–4: 7. annual international Pittsburgh coal conference, Pittsburgh, PA (United States), 10-14 Sep 1990). Order Number DE91018710. Source: OSTI; NTIS; GPO Dep.

Since coal bioprocessing is a heterogeneous reaction a productive bioreactor must contain the highest possible surface area per unit volume. This implies a high concentration of finely ground coal. "Heap" or "pile" type reactors have a high coal concentration, but it cannot be finely ground or it would blow away and the pile would become waterlogged when the solution of nutrients and bacteria was sprayed over it. Waterlogging stops microbial activity by preventing oxygen diffusion into the pile. In the alternative "slurry" type of reactor the coal can be finely ground, but the slurry concentration is limited. Increasing the concentration not only increases the demand for oxygen, it also dramatically reduces the oxygen transfer rate into the slurry. This is due to coalescence of the air bubbles into a few large bubbles which transfer oxygen inefficiently. Thus the productivity of both reactor types is ultimately limited by oxygen transfer. Experimental data and theoretical calculations relevant to this problem are presented. They include oxygen transfer rate versus slurry concentration curves for a 200 liter aerated trough, and liquid holdup versus liquid flow rate curves for coal piles of various particle sizes. The permeability of coal piles to airflow is given as a function of a particle size and liquid holdup. The implications of these data for choosing a reactor type for different bioprocessing operations is discussed. 11 refs., 5 figs.

**33585** **Optical access port.** Lutz, S.A.; Anderson, R.J. To Dept. of Energy. 14 Sep 1988. USA Patent patent application 7-244,758. 18p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91017341. Source: OSTI; NTIS; GPO Dep.

A 0.025 m diameter optical access port system is provided for a high-pressure (20.4 bars) and high-temperature (538°C) fixed-bed coal gasification process stream. A pair of proximal channels lead into the pipe containing the process stream with the proximal channels disposed on opposite sides of the pipe and coaxial. A pair of ball valves are attached to respective ends of proximal channels for fluidly closing the respective channels in a closed position and for providing a fluid and optical aperture in an open position. A pair of distal channels are connected to respective ball valves. These distal channels are also coaxial with each other and with the proximal channels. Each distal channel includes an optical window disposed therein and associated sealing gaskets. A purge gas is introduced into each distal channel adjacent a respective optical window. The purge gas is heated by a heater before entry into the distal channels. Preferably the optical windows are made of fused silica and the seals are Grafoil gaskets which are pressed against the optical window. 3 figs.

**33586** (SAND–91-1463) **Interim report on conversion of coal to liquids via catalytic hydropyrolysis.** Klavetter, E.A.; Salgado, L.V. Sandia National Labs., Albuquerque, NM (United States). Aug 1991. 31p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91018127. Source: OSTI; NTIS; GPO Dep.

The catalytic hydropyrolysis tests performed on coals of varying rank clearly show that high conversions and tar yields can be achieved in a fixed-bed laboratory reactor system. Each of the three types of catalysts utilized, $MoS_2$ derived from dioxydithiomolybdate, the metal HTO catalysts, and the Pd colloidal catalysts, were shown to be effective for the bituminous coals tested. For the lower rank coals, no significant increase in conversions or tar yields preliminary tests utilizing oil agglomeration as a pretreatment provided encouraging results, with conversions and tar yields achieved similar to using the metal HTO and colloid catalysts. This pretreatment process might be effective for use in catalyst dispersal and coal cleaning, and facilitating coal introduction into a high-pressure reactor. In summary, the data obtained show that catalytic hydropyrolysis on a laboratory scale can achieve the necessary conversions and tar yields to be considered as a potentially viable process for converting coal into liquid products. Through proper dispersal of selected catalysts onto bituminous coals, conversions greater than 80% and tar yields greater than 70% can be achieved at low active metal concentrations. 12 refs., 9 figs., 7 tabs.

**33587** (SAND–91-1637C) **Formation and characterization of highly-dispersed iron catalysts.** Wilcoxon, J.P.; Sylwester, A.; Nigrey, P.; Martino, A.; Quintana, C.; Baughman, R.J. Sandia National Labs., Albuquerque, NM (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911041–2: 8. annual international Pittsburgh coal conference: coal - energy and the environment, Pittsburgh, PA (United States), 14-18 Oct 1991). Order Number DE91019055. Source: OSTI; NTIS; GPO Dep.

We are developing small (1–10 nm) iron (Fe) particles in inverse micelles as highly-dispersed catalysts for coal liquefaction. Chemical reduction of iron salts in the hydrophilic core of an oil-continuous inverse micelle system results in stable iron colloids dispersed in an organic solvent. Reaction with sulfur compounds in the same environment produces $FeS_x$ (x=1–2) particles. The Fe particle size and size distributions are analyzed by in-situ light scattering, electronic spectroscopy, and transmission electron microscopy (TEM). Size control is achieved by variation of the number of metal ions per micelle, or by varying the average size or aggregation number of the micelles through changes in the solvent or surfactant system used, or by type of precursor metal salt and reduction chemistry. This approach is quite general and we have demonstrated the ability to control the composition, size, and size distribution for a wide range of other catalytic metals, metal compounds, and metal alloys, including nickel, palladium, molybdenum, and cobalt. We have also demonstrated methods of surface stabilization and surfactant extraction which enable the use of these particles as unsupported catalysts at elevated temperatures and pressures in model catalytic reactions (i.e., pyrene hydrogenation). 4 refs., 4 figs., 2 tabs.

**33588** (SAND–91-7081C) **Quantification of progress in indirect coal liquefaction: Period of performance, 4 April 1990–31 July 1991.** Gray, D.; ElSawy, A.; Tomlinson, G. Mitre Corp., McLean, VA (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109211–3: Direct liquefaction contractors' review meeting, Pittsburgh, PA (United States), 3-5 Sep 1991). Order Number DE92000793. Source: OSTI; NTIS; GPO Dep.

The objective of this study is to quantify the economic and technical impact of incorporating various advanced technologies into the indirect coal liquefaction system. These advanced technologies include entrained flow Shell gasification and slurry-phase Fischer-Tropsch (F-T) synthesis. This objective was accomplished by substituting the Shell entrained goal gasifier system for the Lurgi and the advanced slurry F-T reactor for the Synthol and ARGE F-T systems in a SASOL-type indirect liquefaction facility. 4 refs., 3 figs., 2 tabs.

## 0106 Properties and Composition

*Refer also to citation(s) 33542, 33543, 33562, 33566, 33567, 33569, 33571, 33573, 33574, 33583, 33636, 33639*

**33589** (ANL/CP–73182) **Monomers in coal macromolecules.** Winans, R.E.; McBeth, R.L.; Hunt, J.E.; Melnikov, P.E. Argonne National Lab., IL (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910902–7: 1991 international conference on coal science, Newcastle upon Tyne (United Kingdom), 16-20 Sep 1991). Order Number DE91018637. Source: OSTI; NTIS; GPO Dep.

The objective of this study is to elucidate the nature of the thermally stable monomers released from coal macromolecules upon heating. Although these species represent only a portion of the coal structure which varies with rank, these molecules pay important roles in a variety of coal reactions. These reactions include: pyrolysis, hydropyrolysis, and the early stages of liquefaction, gasification and combustion. In addition to characterization of the pyrolysis fragments, the solvent extractable material which may or may not be thermally extractable requires detailed characterization. The approaches used in this study rely on a number of mass spectrometric techniques, including: fast atom bombardment (FAB) MS, laser desorption (LD) time-of-flight MS, and desorption chemical ionization (DCI) MS, along with tandem MS and high resolution (HR) MS. The eight coals from the Argonne Premium Coal Sample Bank are used in this study along with these coals demineralized, and solvent extracted and the extracts themselves. 10 refs., 2 figs., 1 tab.

**33590** (DOE/MC/23075–2973, pp. 12-64) **Coal to char chemistry submodel development and evaluation.** Hamblen, D.G. (Advanced Fuel Research, Inc., East Hartford, CT (USA)); Serio, M.A. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The objective of this subtask is to develop and evaluate, by comparison with laboratory experiments, an integrated and compatible submodel to describe the organic chemistry and physical changes occurring during the transformation from coal to char in coal conversion processes. Work continued on simulating the experimental data obtained on the coal optical properties obtained from FT-IR transmission (pellet) experiments and on-line FT-IR emission/transmission experiments. A significant amount of work was done on the viscosity (fluidity) model. Additional swelling experiments were done in the drop tube furnace on pure maceral samples to resolve the questions as to whether observed differences in swelling behavior were due to differences in maceral types. Work began on the investigation of percolation theory instead of the Monte Carlo approach as the basis for their network decomposition model. An independent investigation was made of the rank dependence of the pyrolysis kinetics by doing experiments in a TG-FTIR reactor over a series of heating rates (3, 30, 50, 100C/min) with coals from the Argonne set. Work also began on adding polymethylene species to

the FG-DVC model and on improving the submodel for tar vaporization. Results from these studies are presented and discussed.

33591 (DOE/PC/88921–9) **Spin-mapping of coal structures with ESE and ENDOR: Ninth quarterly report.** Belford, R.L.; Clarkson, R.B. Illinois Univ., Urbana, IL (United States). 1 Dec 1990. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88921. Order Number DE92000301. Source: OSTI; NTIS; GPO Dep.

To ENDOR and ESE we have added another advanced EPR technique. VHF-EPR, as a tool with which to observe coal molecular structure, especially organic sulfur. We have constructed a unique VHF EPR instrument operating at the W-band (96 Ghz), one of only two such instruments in the world, and the only one studying coal. We are employing this instrument, as well as collaborating with scientists at Cornell University, who have a 250 GHz spectrometer, to develop a clearer understanding of the relationships between the VHF EPR spectra we observe from Illinois coal and the organic sulfur species present in it. Efforts in this quarter focussed on three area: recruitment of personnel (especially a new postdoctoral fellow) to join the coal research team work on improving the W-band spectrometer, and studies of vitrinite, sporinite, and fusinite macerals at G-band (250 GHz). All three areas have shown good progress. This report will discuss in detail the main features of the W-band instrument, stressing its unique engineering features as well as comparing it to the few other instruments in the world operating in the VHF frequency range (90–250 GHz). Preliminary analysis of the 250 GHz data on macerals obtained by density gradient centrifugation from an Illinois #6 coal gives the first indication that at the very highest frequencies, there may be a separation of the heteroatom VHF EPR signals into a sulfur and on oxygen-containing component. 15 refs., 9 figs., 1 tab.

33592 (DOE/PC/88921–10) **Spin-mapping of coal structures with ESE and ENDOR: Tenth quarterly report.** Belford, R.L.; Clarkson, R.B. Illinois Univ., Urbana, IL (United States). 1 Mar 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88921. Order Number DE92000295. Source: OSTI; NTIS; GPO Dep.

Advanced EPR methods have demonstrated cability for study of molecular components (including organic sulfur) in coal. We have constructed a unique Very High Frequency Electron Paramagnetic Resonance (VHF EPR) instrument operating at the W-band (96 GHz), one of only two such instruments in the world, and the only one studying coal. We are employing this instrument, as well as collaborating with scientists at Cornell University who have constructed a 250 GHz EPR spectrometer, to develop a clearer understanding of the relationships between the VHF EPR spectra we observe from Illinois coal and the organic sulfur species present in it. Work this Quarter for this DOE grant (supplemented by a one-year award through the Illinois Center for Research on Sulfur in Coal and also reported to that agency) has focussed on three main area: (1) synthesis and analysis of model systems for thiophenic sulfur species in coal; (2) Electron Spin Echo and VHF EPR of inertinites from an Illinois #6 coal, as well as evaluation of the sensitivity of the signals from this maceral to oxygen; (3) VHF EPR of iodinated coals. 1 ref., 8 figs.

33593 (DOE/PC/88939–T2) **Methane formation and retention in coal: Quarterly technical progress report, April 1, 1991–June 30, 1991.** Hucka, V.J. Utah Univ., Salt Lake City, UT (United States). Dept. of Mining Engineering. [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88939. Order Number DE91018627. Source: OSTI; NTIS; GPO Dep.

The methane content of coal seams in Utah and Colorado are measured in situ as well as in the laboratory and correlated with the geological and geochemical history of the seams and surrounding strata. Chemical and physical properties are measured in the laboratory for coals that contain methane and coals of similar rank which do not contain methane. Methane yields on pyrolysis are used to measure the propensity of coals to form additional methane. Methane formation and retention will be interpreted in terms of the physical and chemical properties of the coal and the chemical and geological history of the coal seam. 1 ref., 13 figs., 1 tab.

33594 (DOE/PC/90298–T4) **Catalysis and co-catalysis of bond cleavages in coal and coal analogs: Quarterly report, May 1–July 31, 1991.** Miller, B. Massachusetts Univ., Amherst, MA (United States). Dept. of Chemistry. [1991]. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90298. Order Number DE92000334. Source: OSTI; NTIS; GPO Dep.

Short communication. COAL/chemical bonds; PROGRESS REPORT; COAL; CATALYSTS; HYDROGEN TRANSFER; AROMATICS; REACTION INTERMEDIATES

33595 (DOE/PC/90751–T9, pp. 3.1-3.7) **Task 3 - Advanced techniques for coal and mineral characterization.** Shah, N. (Univ. of Kentucky, Lexington (USA)); Huggins, F.E.; Huffman, G.P. PSI Technology Co., Andover, MA (United States). May 1989. In *Transformations of inorganic coal constituents in combustion systems. Quarterly report No. 10 for the period January to March 1989.* 144p. Order Number DE91010549. Source: OSTI; NTIS.

In response to requests from several of the program investigators for additional information regarding the mineralogy of the seven coals utilized in this program, detailed CCSEM (computer-controlled scanning electron microscopy) results for these samples were tabulated. The data, presented in Table 1 (Sections A - G) include all minor species detected in the coals as well as the major minerals (quartz, illite, kaolinite, pyrite) reported previously. Average chemical composition for each mineral class from a given coal is also reported. As comparison among the seven coals indicates, only the miscellaneous silicates category demonstrated any variation in chemistry. For the major mineral species, chemical composition including levels of trace species (e.g., iron in illite) was constant throughout.

33596 (DOE/PETC/TR–91/6) **Sulfur and ash reduction potential and selected chemical and physical properties of United States coals: Executive summary.** Cavallaro, J.A. (USDOE Pittsburgh Energy Technology Center, PA (USA)); Deurbrouck, A.W.; Killmeyer, R.P.; Fuchs, W.; Jacobsen, P.S. USDOE Pittsburgh Energy Technology Center, PA (United States). Sep 1991. 309p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91015938. Source: OSTI; NTIS; GPO Dep.

This report summarizes the washability and comprehensive characterization of 975 raw coal channel samples collected from the Eastern, Central, and Western Regions (including Alaska) of the United States. All of this information is sorted in the Pittsburgh Energy Technology Center (PETC) Coal Technology Data Base. Individual reports for each region were completed previously as Volumes 1, 2, and 3 and included the detailed data for each of the 975 samples. This report is a summation of the results of those three reports on a state- and region-wide basis only, and does not include the data for individual samples, but only includes the composite data for each state and region. Graphical summations are presented by state, section or rank, and region showing the effects of crushing on impurity reductions and showing the distribution of raw and clean coal samples meeting various levels of $SO_2$ emissions. The statistical evaluations in the Appendices present the composited washability data of 1.30, 1.40, and 1.60 specific gravities of separation, the selected chemical and physical properties, and the composited washability data interpolated at various levels of Btu recovery. 13 refs., 93 figs., 9 tabs.

33597 (IS-T–1423) **Characterization of the Argonne premium coals by using NMR of hydrogen and carbon-13 and FTIR spectroscopy.** dela Rosa, L.C. Ames Lab., IA (United States). Aug 1991. 120p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE91018124. Source: OSTI; NTIS; GPO Dep.

Argonne Premium Coal sample Program coals were analyzed by using a variety of transient techniques in NMR of $^{1}H$ (relaxation measurements, spin counting) and $^{13}C$ in coals as well as by using Fourier transform infrared spectroscopy. The quantitative validity of the techniques was evaluated. The true lineshape of the on-resonance $^{1}H$ free induction decay (FID) for coals with <2% moisture content was determined by solid echo and described by a superposition of Gaussian and Lorentzian decay functions, corresponding to rigid protons in the macrostructure of coal and to

fragments in the coal exhibiting hindered molecular mobility, respectively. For wet coals, an additional slowly decaying Lorentzian fraction must be added to the description of the FID. The species responsible for the longest decay was identified. The NMR quantitation results compared favorably with the results obtained by chemical and thermogravimetric analyses. 99 refs., 16 figs., 2 tabs.

**33598** (PNL-SA–17644) **Characterization of the coal biosolubilization process using gel permeation chromatography and CPMAS NMR.** Linehan, J.C.; Bean, R.M.; Franz, J.A.; Campbell, J.A. Pacific Northwest Lab., Richland, WA (United States). May 1990. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-900531–7: 1. international symposium on the biological processing of coal, Orlando, FL (United States), 1-3 May 1990). Order Number DE92000798. Source: OSTI; NTIS; GPO Dep.

Leonardite, an oxidized lignite, and Illinois #6 coal were treated with Trametes versicolor and Penicillium sp., respectively, and separately with aqueous base to yield soluble and insoluble products. The products and starting materials were analyzed by gel permeation chromatography (GPC), using both aqueous and organic eluents, and by high-field, high-speed-pinning (>10.0 kHz) $^{13}C$ cross polarization/magic angle spinning (CPMAS) nuclear magnetic resonance spectroscopy (NMR). The weight average molecular weights ($M_w$) of the fungal-and base-solubilized products determined by GPC using acidic tetrahydrofuran (THF) eluent were found to be consistently lower than the $M_w$ determined using basic aqueous eluents. The $M_w$ of the leonardite product was measured to be 1800 and 6100 daltons using the THF and aqueous eluents, respectively. The aqueous eluent (phosphate buffered at pH 11.5) was found to be superior to the THF eluent in its solubilizing power, with 10% more material analyzed with the basic eluent. The solubility of the biotreated products in aqueous base was greater than either the starting coal or the chemically solubilized product. The Trametes-solubilized leonardite was found to contain a higher percentage of aliphatic carbon than the raw lignite; the Penicillium-solubilized Illinois #6 contained more aromatic carbon than before fungal treatment as determined by $^{13}C$ CPMAS NMR. Pre-oxidation of Illinois #6 decreases the relative amount of aliphatic carbon. The high-field, high-speed-spinning CPMAS NMR technique was quantitatively evaluated using Argonne premium coals,International Humic Society Standards, and model compounds at various temperatures. 7 refs., 4 figs., 3 tabs.

## 0108 Waste Management

*Refer also to citation(s) 33578, 33976, 33977, 33978, 33979, 33980, 33981*

**33599** (DOE/MC/23075–2973, pp. 170-194) **$SO_x/NO_x$ submodel development.** Boardman, R.D. (Brigham Young Univ., Provo, UT (USA)); Smoot, L.D.; Brewster, B.S. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The objectives of this subtask are (1) to extend an existing pollutant s ubmodel in PCGC- 2 for predicting $NO_x$, formation and destruction to include thermal NO, (2) to extend the submodel to include $SO_x$ reactions and $SO_x$-sorbent reactions (effects of $S0_3$ non-equilibrium in the gas phase will be considered), and (3) to consider the effects of fuel-rich conditions and high pressure on sulfur and nitrogen chemistry in pulverized-fuel systems. The Zeldovich mechanism has been fully integrated into the $NO_x$ submodel and coupled with turbulence. Improvements have been made to the numerical approach of the model to increase efficiency and improve robustness of the code when the non-linear rate expression describing thermal NO formation is used. Additions have been made in fuel NO predictions by adding reactions through intermediate $NH_3$ to improve prediction of low-rank coal NO formation in fuel-rich conditions. In addition, an alternative joint fuel NO and thermal NO mechanism has been incorporated into the code for potential prediction of low-rank coals and fuel-staging processes. Thermal $NO_x$ data have been collected under independent funding at BYU and are being used to verify the thermal NO option of the $NO_x$ submodel, independently from fuel NO formation. Equilibrium predictions for $SO_2$ and $H_2S$ have been completed for combustion of bituminous and subbituminous coal and compared with data. Work tasks required to complete a sorbent-capture submodel have been identified and planned.

**33600** (DOE/MC/23075–2973, pp. 195-235) **$SO_x/NO_x$ submodel evaluation.** Hedman, P.O. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The objectives of this subtask were: (1) to obtain detailed turbulence measurements for radial crossjet injection of sorbent particles in a cold-flow f acivity designed to replicate the geometry of a 2-D combustor/gasifier, (2) to obtain concentration profile data for sulfur and nitrogen pollutant species from laboratory-scale, coal reaction tests at atmospheric and elevated pressure with and without sulfur sorbents, and (3) to investigate the effect of pressure on the effectiveness of sorbent injection in capturing sulfur pollutants. These data were obtained so that sorbent-flow and sulfur-capture information would be available for sorbent submodel evaluation. This subtask was completed during the past year. The paper describes results on the following: sorbent mixing fluid mechanics, flow visualization tests, mapping of trace gas data, laser-Doppler velocity measurements, and space-resolved sulfur and nitrogen pollutant measurements.

**33601** (DOE/PC/88943–T3) **$N_2O$ formation from advanced $NO_x$ control processes (selective non-catalytic reduction and coal reburning): Final report.** Montgomery, T.A. (Fossil Energy Research Corp., Laguna Hills, CA (United States)); Martz, T.D.; Quartucy, G.C.; Muzio, L.J.; Sheldon, M.S.; Cole, J.A.; Kramlich, J.C.; Samuelsen, G.S.; Reddy, V. Fossil Energy Research Corp., Laguna Hills, CA (United States). Apr 1991. 231p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-88PC88943. Order Number DE91018259. Source: OSTI; NTIS; GPO Dep.

The current work addressed the potential of $N_2O$ production from two $NO_x$ reduction techniques: selective non-catalytic $NO_x$ reduction (SNCR processes) and reburning with pulverized coal. The effects of SNCR processes (utilizing ammonia, urea, and cyanuric acid injection) and reburning processes (with bituminous and lignite coals) upon $NO_x$ and $N_2O$ levels were evaluated. Pilot scale testing and chemical kinetic modeling were used to characterize the $N_2$ production from SNCR processes over a range of process parameters. The data show that the evaluated SNCR processes (ammonia, urea, and cyanuric acid injection) produced some $N_2O$ as a by-product. Ammonia injection produced the lowest levels of $N_2O$; less than 4% of the reduced $NO_x$ was converted to $N_2O$. Cyanuric acid injection produced the highest levels; $N_2O$ increases ranged between 12–40% of the reduced $NO_x$. The conversion of $NO_x$ to $N_2O$ with urea injection ranged from 7–25%. Pilot scale testing was used to characterize the $N_2O$ production from reburning processes with coal over a range of process parameters. Parameters included: coal type, firing rate, initial NO level, and reburn zone stoichiometry. Data show that $N_2O$ is not a major product during coal reburning processes for $NO_x$ reduction. 56 figs., 13 tabs.

**33602** (DOE/PC/89805–5) **Cross-flow, filter-sorbent catalyst for particulate, $SO_2$ and $NO_x$ control: Sixth quarterly technical progress report.** Benedek, K. (Little (Arthur D.), Inc., Cambridge, MA (United States)); Flytzani-Stephanopoulos, M. Little (Arthur D.), Inc., Cambridge, MA (United States). Aug 1991. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89PC89805. Order Number DE91018625. Source: OSTI; NTIS; GPO Dep.

The first stage of work on the development a single-unit, cross flow filter-sorbent-catalyst will be the investigation of $SO_2$ removal and $NO_x$ reduction characteristics of different sorbent-catalyst compositions (in bulk, granular form). We will conduct exploratory tests of cross-flow filters under conditions similar to those found in the combustion gases of small-scale combustors. After a year of these fundamental studies, we will conduct a preliminary evaluation of

the component performance and will design two or three prototype configurations. We will also investigate the pollutant control characteristics of prototype filter-sorbent-catalyst devices. The $SO_2$ removal and $NO_x$ reduction efficiency of a "unit-element" prototype will be investigated. This "unit-element" will be a slot reactor comprised of two flat porous walls, or "slabs" of filter-sorbent-catalyst material separated by a 0.5 centimeter gap. The particulate collection efficiency and back-flushing requirements of a multi-element version of this device will be tested. We estimate that better than 90% removal efficiency of $SO_2$ and $NO_x$ is achievable with the use of mixed metal oxides (CuO, $CeO_2$) in the device. Also, high sulfur capacity is possible by increasing the metal oxide content of the active $SO_2$ sorbent phase. Aluminum oxide, $Al_2O_3$, is planned to be used as a dispersant and/or catalyst support in the active sorbent-catalyst layer(s). Concurrent with these efforts will be the investigation of a sorbent regeneration scheme that has the potential to produce elemental sulfur in a one step process. 8 refs., 8 figs., 8 tabs.

## 0120 Mining

*Refer also to citation(s) 33617, 33684, 33685, 34257*

**33603** (ETDE-mf–2704576) **Development of an integrated, modern protection relay for the power supply in German coal mine power networks.** Handschin, E.; Ebbinghaus, W.; Eickhoff, F.; Jaspert, M. Dortmund Univ. (Germany). Lehrstuhl fuer Elektrische Energieversorgung; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Mar 1990 144p. (In German). Contract BMFT 03E6395A. Order Number DE92704576. Source: OSTI; NTIS (US Sales Only).

An integrated telemetry and control and protection system has been developed for the electric power supply in coal mines. A prototype of the system, consisting of a digital protection relay, a communication computer and a control computer, was constructed. The necessary requirements for protection systems are acquired together with experts from the mines. The system meets the basic requirements. A field test with practical conditions was carried out. The research project was adapted to other research projects for the coal mine process control. In coal mine power supply the developed digital protection system and its integration of the protection into the control system offers several advantages: Selective digital protection functions non sensitive towards high-order harmonics; programmable protection relay including all common protection functions in one system and a communication interface for telemetry and process control; continuous internal and external fault monitoring for increasing availability; central supervision of the protection functions and the parameter assignment; fast parameter change for adaption to a new network configuration increases the safety of the protection; central data acquisition for automatic analysis of protection alarms allows fault location and fast network restoration; central monitoring and control of the energy distribution; long term data acquisition of voltage and current diagrams and load curves as basic information for network planning and operation. (orig.).

**33604** (KTM/E-B–87) **OPTIMITURVE Peat production based on solar enrgy: interim report 1988-1990.** Leinonen, A. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab.). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 81p. Project KTM-275/881/87. Order Number DE92703971. Source: OSTI; NTIS (US Sales Only).

Finland's energy research programme Publishd also in Finnish Report no B:86.

The aim of the programme has been approached by developing new milled peat and sod peat production techniques. In milled peat production, the following new techniques have been introduced: the mole drainage technique, the new concept of milled peat production machine chain, the new Suurtehohaku method, thermo-camera storage control by airplane, a new production control method, and new production control equipment, like an accurate peat moisture meter, an ultra-sound measurement meter to measure the thickness of the peat layer and a mini-radar for rain prediction. In sod peat production the main results of the research include the ridge drying method, a new surface sod cutter, and the so-called Multi method. With these new techniques milled peat production has now been able to reach 69 % of the original aim set for the programme, when all the new developments are taken into consideration. Most of these results can only by utilized in the production areas that are larger than 200 hectares in size. The new sod peat production technique accounts for over 70 % of the results set for this research. Other research results that contribute to the overall aim of the programme are theoretical foundations for the study of the hydrology of peatlands, peat cutting, moulding and drying, modelling of peat production costs, a simulation model for peat production, as well as a calculation method for the yield per hectare, where weather conditions, as one factor, are taken into consideration.

**33605** (OY/PSTL-TIED–75) **The possibilities of aircraft photography in different stages of utilization of peatlands.** Paajala, J.; Kauppi, H. Oulu Univ. (Finland). Research Inst. of Northern Finland. Dec 1990. 28p. (In Finnish). Order Number DE92703997. Source: OSTI; NTIS (US Sales Only).

The utilization possibilities of aircraft photography in different stages of peat production have been studied in this research. The main principles of different methods of aircraft photography, and such special features which might effect on the research have been described. The orderers of the research have given their opinions of the stages of peat production, which might be more economical and more useful when done by aircraft photography than manually. The most useful applications of aircraft photography and the corresponding traditional methods have been compared with each other on the basis of given criteria. Comparison has been made by interviewing the experts of peat production and aircraft photography. Color infrared photography is suitable especially for determination of moisture content and surface plantation, and streo photography for measurement of height profiles and stockpile volumes. The research is basic research and the obtained results first estimates especially from the economical point of view. Additionally several other needs for research have been obtained in the inquiry.

**33606** (VTT-OPT–9) **Fundamentals of sod peat technology - field test machine and sod simulator research.** Erkkilae, A.; Aalto, J.; Toivonen, H. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1991. 67p. (In Finnish). Project KTM-357/881/86. Order Number DE92703979. Source: OSTI; NTIS (US Sales Only).

OPTIMITURVE Research Programme.

Field test machine and sod simulator research is one of the three sub tasks of the project fundamentals of sod peat technology. Cutting of peat, harvesting and maceration of it, and spreading technology were researched. Test equipment, a test sod machine and sod peat machine simulator, needed in both field and laboratory tests were planned and construted during this sub project. The measuring methods for degree of maceration and strength of sod were also developed. The aim of the laboratory tests was to clarify the effects of degree of maceration and final moisture content of sod on strength and density of sod. In field test e.g. the amount of air in the sod, and the effects of revolution speeds of both the cutting disc and the macerator on particle size and energy demand were tested using the test sod peat machine.

**33607** (VTT-OPT–14) **Sod-peat drying research.** Jaervinen, T.; Frilander, P. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1991. 43p. (In Finnish). Project KTM-357/881/86. Order Number DE92703980. Source: OSTI; NTIS (US Sales Only).

OPTIMITURVE Research Programme.

The results of sod-peat drying studies are presented in this report. Drying of the sods in the simulator under constant and varying weather conditions were researched. Additionally, the field drying tests were performed in order to confirm the simulator results and the general concept. The simulator tests proved that the constant drying rate period was short under the conditions programmed into the simulator. Therefore the main portion of the water was evaporated also out of the inner parts of the sods as a vapour into the surroundings. The portion of air in the sods was increased by making holes in them, which improved somewhat the drying of the sod. The high internal distribution of moisture was occurred inside of the sod during the drying in the simulator room

and field tests. The field tests showed that the increasing of the layer to be dried by raising the load extended the drying time almost linearly. The internal distribution of moisture of the sod in field tests was smallest with high roads. However, the variation of moisture content between different layers became high. Thewindrowing of the sods on the field succeeded poorly, and it has no influence on the drying of the sods at the case.

**33608** (VTT-OPT–23) **Development of energy economical cutting device and macerator suitable for different peat qualities.** Erkkilae, A. (Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab.); Hoelttae, P. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1991. 43p. (In Finnish). Project KTM-275/881/87. Order Number DE92703981. Source: OSTI; NTIS (US Sales Only).

OPTIMITURVE Research Programme.

The aim of this research was to increase the seasonal yield of sod peat by using an efficient cutting device, and to improve the strength and density of sod peat by developing peat maceration. The aim was endeavoured by constructing a new cuttng disc and by investigating the properties of it. The effects of the degree of maceration and sod forming conditions on density and strength of sod was also investigated. Peat of different degrees of maceration were produced with cutting discs and macerator worms. The effects of macerators on pressure and pressure variation, and elimination of pressure shocks caused by the blades of the macerator worm were also investigated. Sod peat machine simulator was used in laboratory tests and experimental sod peat machine in the field tests. The energy consumption of sod peat production was measured in the research. The project was fulfilled in cooperation with three industriai tasks researching sod peat, the results of which were used e.g. in comparison of sod qualities of worm cutting and disc cutting devices.

**33609** (VTT-OPT–27) **Fast preparation and more accurate utilization of the peat production area.** Leiviskae, V. (Oulu Univ. (Finland). Research Inst. of Northern Finland). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1991. 34p. (In Finnish). Project KTM-16/881/88. Order Number DE92703984. Source: OSTI; NTIS (US Sales Only).

OPTIMITURVE Research Programme.

This report concerns with removal of weakly decomposed surface peat and extraction of humified substratum peat during frost time in winter. In addition the preconditions of the spring drying of peat have been investigated. The costs of the removal of weakly decomposed peat in frozen state has been estimated to be 35 - 45 % higher than the present screw levelling method. Horticultural and environmental peat can be produced as frozen peat pieces. Peat pieces of thickness 12 - 15 cm obtained 50 % moisture content by the end of July. By estimated production capacities the production costs of frozen peat pieces seems to be 36- 41 mk/$m^3$. For extraction of humified substratum peat this method is not suitable by reasons of technical difficulties and high production costs. Because the net evaporation is in May approximately as high as that for June and July there are in principle good chances for peat production in May. The milling tests in spring 1989 and 1990 that we may speed up the start of production season to some degree, about one crop cycle.

**33610** (VTT-OPT–30) **Research results of the Optimiturve research program in 1990.** Alakangas, E. (ed.). Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1991. 69p. (In Finnish). Project KTM-275/881/87. Order Number DE92703982. Source: OSTI; NTIS (US Sales Only).

OPTIMITURVE Research Programme.

Optimiturve research program is one of the energy research programs funded by the Ministry of Trade and Industry of Finland. The main target of the program is to double the annual yield per hectare of peat, dried by solar energy, to decrease the production costs of peat, to increase the speed of circulation of capital invested in peat production with the aid of a new production method developed in this research, and hence improve the price competitivity of peat. The targets of the research program are expected to be completed by improving the drying of peat, the efficiency of the peat production machinery, and by improving the product quality. The program was started in 1988, and the targets are to be fulfilled up to the year 1993. The research program is carried out in cooperation with universities, research institutions and peat producers. This publication consists of the results of the ongoing projects in the Optimiturve research program. The aim, contents and the main results of the 18 projects are preseted. At the end of this publication there is a list of the publications and other reports of the Optimiturve research program.

**33611** (VTT-OPT–33) **The drying of milled peat.** Hillebrand, K.; Kallio, M.; Frilander, P. Technical Research Centre of Finland, Jyvaeskylae (Finland). Combustion and Thermal Engineering Lab. 1991. 62p. (In Finnish). Project KTM-275/881/87. Order Number DE92703985. Source: OSTI; NTIS (US Sales Only).

OPTIMITURVE Research Programme.

In this paper the study of milled peat drying in the weather and field condition simulator, the drying theory of porous media, the experimental design and the multivariate data analysis system are described. An experimental design for milled peat drying in 35 experiments was made. Principal Component Analysis (PCA) and Partial Least Squares (PLS) Regression were used to analyze the experimental results. Due to the nonlinearity of the drying process, a power model for drying was constructed. The predicted drying times calculated from the model are in good agreement with the experimental results. From the variance of the drying time, 94 % is explained when two principal components are calculated. The third principal component will explain very minor addition to the unexplained part of the experimental data. The drying model can be used to study the effect of different variables on the drying time of the milled peat layer. According to the model, the most important variables for the drying rate are the specific loading rate, the initial moisture content of the peat and solar radiation. Doubling the specific loading rate or the initial moisture content will increase the drying time of the layer by about 2.5 and 3.0 times, respectively. Doubling the solar radiation will decrease the drying time in half. The effects of the other variables in the drying model (air temperature, relative humidity, wind speed, average particle size, number of turnings) are in the same order with each other. Doubling the initial value of one variable will increase or decrease the drying time 1.1 - 1.2 times, depending on the variable considered.

**33612** (VTT-TIED–1211) **Wireless stopping system as safety device on asphalt and stone crushing plants.** Tiusanen, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Turvallisustekniikan Lab.); Kivipuro, M. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1991. 50p. (In Finnish). Order Number DE92704016. Source: OSTI; NTIS (US Sales Only).

The purpose of this research was to develop a reliable wireless stopping system to be used as safety device on asphalt and stone crushing plants. A couple of commercial remote control systems were tested and it was founded out that they were not reliable enough to be used in such hard and interference circumstances. The developed remote radio control system improves the occupational safety of the asphalt and stone crushing plants by making it possible to stop the material processing equipments from the whole area of operation. The system can also be used as safety device on other similiar industrial plants.

## 0130 Transport, Handling, and Storage

**33613** (DOE/CE/15466–T4) **Coal-log pipeline system development: Quarterly report No. 4, May 25, 1991–August 24, 1991.** Missouri Univ., Columbia, MO (United States). Dept. of Civil Engineering. [1991]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG01-90CE15466. Order Number DE91018431. Source: OSTI; NTIS; GPO Dep.

Progress made from August 24, 1990–June 30, 1992 is reported. The project tasks are to perform the necessary testing and development to demonstrate that the amount of binder in coal logs can be reduced to 8% or lower to produce logs with adequate strength to eliminate breakage during pipeline transportation, under conditions experienced in long distance pipeline systems. Prior to conducting any testing and demonstration, grantee shall perform an information search and make full determination of all previous

attempts to extrude or briquette coal, upon which the testing and demonstration shall be based. Perform the necessary development to demonstrate a small model of the most promising injection system for coal-logs, and test the logs from Task 1. Conduct economic analysis of coal-log pipeline, based upon the work to date. Refine and complete the economic model. Prepare a final report for DOE.

**33614** (DOE/EIA–0549) **Trends in contract coal transportation, 1979–1987.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 11 Sep 1991. 91p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018976. Source: OSTI; NTIS; GPO; GPO Dep.

The Energy Information Administration (EIA) is required to carry out a central, comprehensive, and unified energy data information program that will collect, evaluate, assemble, analyze, and disseminate data and information relevant to energy resources, reserves, production, demand, technology, and related economic and statistical information. As part of the EIA program to provide information on coal, this report, Trends in Contract Coal Transportation, 1979–1987, presents, describes, and analyzes utility contract coal transportation data from 1979 through 1987. Coal transportation rates are basic to the analysis and forecasting of future coal supply, and are important in the analysis of current coal and electricity markets. This report is designed to provide basic information to aid analysts in the understanding of coal supply and distribution. 12 figs., 40 tabs.

**33615** (DOE/PC/90183–T2) **Dense inclined flows: Theory and experiments: Quarterly technical progress report, April 1, 1991–June 30, 1991.** Cornell Univ., Ithaca, NY (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-91PC90183. Order Number DE91018158. Source: OSTI; NTIS; GPO Dep.

Rapid, gravity-driven flows of granular materials such as, for example, coal, down inclines pose a challenge to our understanding. Even in situations in which the flow is steady and two-dimensional, the details of how momentum and energy are balanced within the flow and at the bottom boundary are not well understood. We have undertaken a research program integrating theory, computer simulation, and experiment that will focus on dense entry flows down inclines. Its goal is to understand the regime of inclined flow that involves a large, relatively passive mass of granular material moving above a narrow region of intensely sheared, colliding grains. The effort involves the development of theory informed by the results of simultaneous computer simulations and the construction, instrumentation, and use of an experimental facility in which the variables necessary to assess the success or failure of the theory can be measured. In the present reporting period, a recently developed theory for identical spheres interacting through frictional collisions has been applied to inclined flows and to shearing flows driven by the relative motion of parallel boundaries. A variety of boundary conditions have been employed. Also, we have started construction of the chute facility and we have conceived and partially assembled an experiment to measure the parameters that characterize collisions between two small glass particles. 3 refs., 1 fig.

**33616** (DOE/PETC/TR–91/10) **Steady flow of a fluid-solid mixture in a circular cylinder.** Johnson, G. (Pittsburgh Univ., PA (United States). Dept. of Mechanical Engineering); Rajagopal, K.R.; Massoudi, M.; Mathur, M.P. USDOE Pittsburgh Energy Technology Center, PA (United States); Oak Ridge Associated Universities, Inc., TN (United States). Sep 1991. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE91018698. Source: OSTI; NTIS; GPO Dep.

A mathematical description for a flowing mixture of solid particulates and a fluid similar to a coal-water slurry, is developed within the context of Mixture Theory. Specifically, the equations governing the flow of a two-component mixture of a Newtonian fluid and a granular solid are derived. These relatively general equations are then reduced to a system of coupled ordinary differential equations describing steady flow of the mixture through a pipe. The resulting boundary value problem is solved numerically and results are presented for cases in which drag and lift interactions are important. 44 refs.

**33617** (ETDE-mf–2714365) **Development of an integrated hydraulic pipe transport system to couple run-of-mine coal haulage and dirt transport with preparation and stowage in the hardcoal industry. Final report.** Siebert, H.C. Technische Hochschule Aachen (Germany). Lehrstuhl und Inst. fuer Bergswerks- und Huettenmaschinenkunde; Ruhrkohle AG, Herne (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Apr 1991 88p. (In German). Contract BMFT 0326688A;BMFT 0326688B. Order Number DE92714365. Source: OSTI; NTIS (US Sales Only).

A comparative examination of transportation costs by means of conventional and hydraulic methods under consideration of additional costs for hydraulic transport due to fines dewatering and yield losses shows that hydraulic transport costs are 6-14% higher compared to the conventional methods of belt conveying or transport in mine cars. For the calculations a tolerance of ± 10% is assumed so that the differential costs range within these limits. Under this project cost advantages of pipe transport systems could not be examined in detail. First estimates show that tangible advantages in favour of hydraulic pipe transport are generated through a cost impact on associated areas. The vision of hydraulic plants is regarded as being cost-efficient, technically advanced and environmentally compatible. In combination with efficient manriding and transport systems hydraulic pipe transport may significantly support innovation in the hardcoal industry. (orig.) With 19 refs., 18 tabs., 8 figs.

## 0140 Combustion

*Refer also to citation(s) 33544, 33549, 33550, 33557, 33564, 33599, 33600, 33601, 33965, 33966, 33969, 33970, 33973, 34776*

**33618** (ANL/CP–72920) **Development of weldments for sulfur-containing combustion environments.** Natesan, K.; Wang, D.Y. Argonne National Lab., IL (United States). Mar 1991. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910909–10: 1. international conference on heat-resistant materials, Lake Geneva, WI (United States), 22-26 Sep 1991). Order Number DE91018573. Source: OSTI; NTIS; GPO Dep.

Alloys Incology 800 H, RA 333 and Haynes 188 weldment materials were exposed in TVA 20-MW and Rocketdyne atmospheric fluidized bed combustors (AFBCs) at 849°C for 1261 and 871°C for upto 1980 h, respectively. Postexposure analyses were conducted at Argonne National Laboratory. All specimens experienced different degrees of internal oxidation/sulfidation. Among eight filler materials, Marathon 25/35R and Haynes 188 showed the least corrosion attack, i.e., less than 0.5 mm/yr. A high nickel content in the weldment was unfavorable for corrosion resistance in the AFBC environment. Differences in the coal/bed chemistry of the TVA and Rocketdyne systems yielded different corrosion behavior in the materials. Calcium sulfate deposits on the specimens significantly affected the internal oxidation/sulfidation of the alloys. The results of this study supplement the material data base, in particular that of weldment performance, and aid in materials selection for AFBC applications. 7 refs., 19 figs., 4 tabs.

**33619** (CONF-911133–2) **Modeling deterministic chaos in gas-fluidized beds.** Daw, C.S. (Oak Ridge National Lab., TN (United States)); Halow, J.S. Oak Ridge National Lab., TN (United States). [1991]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Institute of Chemical Engineers (AIChE) annual meeting; Los Angeles, CA (United States); 17-22 Nov 1991. Order Number DE91018935. Source: OSTI; NTIS; GPO Dep.

Recent experimental studies at Oak National Laboratory and Morgantown Energy Technology Center suggest that the dynamics of gas-fluidized beds is dominated by deterministic chaos. In this paper we demonstrate that deterministic chaos in bubbling fluidized beds can arise readily from nonlinear bubble-to-bubble interactions. Using experimentally observed bubble interaction relationships, a simple one-dimensional model is constructed that exhibits the characteristics features of deterministic chaos. We show also that the dynamical behavior of this simple model is remarkably similar to experimentally observed voidage and pressure fluctuation patterns.

Results from this preliminary study suggest specific directions for future fluidized-bed and applied chaos research. 12 refs., 5 figs.

**33620** (DOE/FE/61614–T1) **Identification of barriers to the use of atmospheric fluidized bed combustion in Kentucky.** Kentucky Coal and Energy Policy Office, Lexington, KY (United States); USDOE Assistant Secretary for Fossil Energy, Washington, DC (United States). Aug 1990. 56p. Sponsored by USDOE, Washington, DC (United States); Kentucky State Government, Frankfort, KY (United States). DOE Contract FG01-88FE61614. Order Number DE91018974. Source: OSTI; NTIS; GPO Dep.

Both Kentucky and the USDOE are committed to development and commercialization of Fluidized Bed Combustion. Kentucky has committed $10 million to, and is a full partner in, the utility-scale 160 MW Atmospheric Fluidized Bed Combustion (AFBC) Demonstration Plant at the Tennessee Valley Authority's Shawnee Steam Plant in Paducah, Kentucky. Kentucky purchased and operates an AFBC pilot plant and conducts tests on alternative coal types, limestone types, boiler-tube corrosion/erosion and other research. The Kentucky General Assembly established a tax credit for the use of AFBC installations. It provides a five year exemption from sales tax, corporate tax, and other taxes for facilities installing AFBC in Kentucky. Despite government and industry commitment to AFBC, despite is potential advantages, and despite its commercial use in several parts of the United States, there is only one industrial facility burning coal using AFBC in Kentucky. This facility uses two units, each rated 60,000 pound per hour AFBC units. One of the driving forces behind the decision to use AFBC at this facility was USDOE funding. Two boilers out of the approximately 800 industrial boilers in the state cannot be considered impressive penetration of the technology. This project was designed to investigate why there is little use of AFBC in Kentucky and to recommend measures to facilitate or encourage its use. 11 figs.

**33621** (DOE/MC/23075–2973, pp. 127-151) **Ash physics and chemistry submodel.** Markham, J. (Advanced Fuel Research, Inc., East Hartford, CT (USA)); Serio, M. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The objective of this task is to develop and validate, by comparison with laboratory experiments, an integrated and compatible submodel to describe the ash physics and chemistry during coal conversion processes. AFR will provide the submodel to BYU together with assistance for its implementation into the BYU PCGC-2 comprehensive code. To accomplish the overall objective, the following specific objectives are: (1) to develop an understanding of the mineral matter phase transformations during ashing and slagging in coal conversion; (2) To investigate the catalytic effect of mineral matter on coal conversion processes. Data acquisition will be focused on: (1) design and implementation of an ash sample collection system; (2) developing methods for mineral characterization in ash particles; (3) developing methods for studying the catalytic effects of minerals on coal gasification.

**33622** (DOE/MC/23075–2973, pp. 237-256) **Integration of advanced submodels into entrained-flow code, with evaluation and documentation.** Brewster, B.S. (Brigham Young Univ. Provo, UT (USA)); Smoot, L.D. Advanced Fuel Research, Inc., East Hartford, CT (United States); Brigham Young Univ., Provo, UT (United States). Feb 1990. In *Measurement and modeling of advanced coal conversion processes. Annual report, October 1988–September 1989.* 310p. Order Number DE91002046. Source: OSTI; NTIS.

The objective of this subtask is to improve and validate an existing 2-D code (PCGC-2) for entrained coal combustion and gasification to be more generally applicable to variation in coal rank and operating conditions. The approach being followed is to (1) incorporate the advanced, coal-general and pollutant submodels being developed under Task 2 into PCGC-2, (2) evaluate the improved code by performing simulations for carefully chosen conditions and by comparing code predictions with experimental data, (3) improve robustness by incorporating available improvements to the numerical algorithms, and (4) improve user-friendliness by implementing the improved code on a workstation with a graphical user interface. Work continued during the past year on integrating the FG-DVC submodel into PCGC-2, evaluating its performance by simulating the transparent wall reactor at AFR, and improving the robustness of thee numerical algorithm and full energy equation option. Development of a user-friendly, graphical interface on the Sun workstation was initiated. Results are discussed.

**33623** (DOE/PC/70768–1) **Kinetics of coal pyrolysis and devolatilization: Technical progress report, September 28, 1984–April 30, 1985.** Seery, D.J.; Freihaut, J.D.; Proscia, W.M. United Technologies Research Center, East Hartford, CT (United States). [1991]. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70768. Order Number DE92000200. Source: OSTI; NTIS; GPO Dep.

The objective of these coordinated experimental and modeling studies is to develop an improved understanding of the kinetics of coal devolatilization which are relevant to suspension firing of powdered coal. These fundamental kinetic studies address several topics related to an improved understanding of pulverized coal combustion and includes both homogeneous and heterogeneous reactions. The principal topics include: (1) the pyrolysis and devolatilization of coal; and (2) the formation of char. Research activities include small-scale experimentation, interpretation of experimental results in terms of mechanistic understanding and the development and validation of kinetic models of fundamental processes. 13 refs., 8 figs., 5 tabs.

**33624** (DOE/PC/70768–4) **Kinetics of coal pyrolysis and devolatilization: Technical progress report, November 1, 1985–January 31, 1986.** Seery, D.J.; Freihaut, J.D.; Proscia, W.M. United Technologies Research Center, East Hartford, CT (United States). [1991]. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70768. Order Number DE92000201. Source: OSTI; NTIS; GPO Dep.

The objective of these coordinated experimental and modeling studies is to develop an improved understanding of the kinetics of coal devolatilization which are relevant to suspension firing of powdered coal. These fundamental kinetic studies address several topics related to an improved understanding of pulverized coal combustion and includes both homogeneous and hetergeneous reactions. The principal topics include: (a) the pyrolysis and devolatilization of coal; and (b) the formation of char. Research activities include small-scale experimentation, interpretation of experimental results in terms of mechanistic understanding and the development and validation of kinetic models of fundamental processes. 6 refs., 20 figs., 7 tabs.

**33625** (DOE/PC/70768–5) **Kinetics of coal pyrolysis and devolatilization: Technical progress report, February 1, 1986–April 30, 1986.** Seery, D.J.; Freihaut, J.D.; Proscia, W.M. United Technologies Research Center, East Hartford, CT (United States). [1991]. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70768. Order Number DE92000202. Source: OSTI; NTIS; GPO Dep.

Research continued on coal pyrolysis and devolatilization. The effects of reaction process on the transient temperature history of a particle have been examined. The reaction process is found to significantly reduce the temperature gradient across a burning particle relative to a nonreactive particle. The pyrolysis process, on the other hand, does not severely affect the temperature history of a heating particle for the kinetic parameters employed. Devolatilization experiments have been performed on various size cuts on an HVA Bituminous coal in entrained flow and heated grid reactors. Weight loss measurements were made in the entrained flow reactor (EFR) and tar yields and molecular weight distributions were measured for the heated grid reactor (HGR) experiments. The results imply the initial phase of the devolatilization of the HVA Bituminous coal is heat transfer controlled because the rate of tar information and evolution is heat transfer controlled. The invariance in EFR ultimate weight loss and low pressure tar yields and characteristics with change in particle size can be explained by morphological considerations of the parent coal particles. The non-symmetric, irregular shapes of the coal particles result in an intraparticle mass distribution much nearer an interphase surface area than that of an equivalent sphere or cube. 5 refs., 37 figs., 9 tabs.

33626 (DOE/PC/70768–8) **Kinetics of coal pyrolysis and devolatilization: Technical progress report, October 1, 1986–December 31, 1986.** United Technologies Research Center, East Hartford, CT (United States). [1986]. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70768. Order Number DE92000203. Source: OSTI; NTIS; GPO Dep.

Research continued on coal devolatilization. Results are presented for rapid devolatilization experiments performed with the 20 – 30 micron size cut of the reference coal - PSOC 1451D - a high volatile bituminous. Appalachian Province coal. In agreement with behavior observed in rapid, radiant transient heating experiments - flash lamp - and moderate heating rate - heated grid - experiments for the same coal, the devolatilization process is observed to occur in four distinct phases: intraparticle heavy hydrocarbon detachment and transport; heavy hydrocarbon desorption; low temperature reformation reactions producing light gases; high temperature secondary reactions of tars and char degassing. Mass fraction yields light fast yields and tar and char characteristics are presented for a range of reactor temperatures which support the phenomenological picture. A phenomenological model is presented which indicates the distinct phases of devolatilization and the importance of heat transfer conditions on both the overall rate of particle mass loss and the observable volatiles product distribution. The approach taken to model heat transfer conditions in each of the devolatilization reactors employed in the overall investigation is outlined. Predicted weight loss results are shown for three different sets of overall devolatilization kinetic parameters given heat transfer conditions in the UTRC Hot Wall - Hot Gas reactor. 47 figs., 1 tab.

33627 (DOE/PC/70768–10) **Kinetics of coal pyrolysis and devolatilization: Technical progress report, May 1, 1987–July 31, 1987.** United Technologies Research Center, East Hartford, CT (United States). [1987]. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70768. Order Number DE92000211. Source: OSTI; NTIS; GPO Dep.

Research continued an coal pyrolysis and devolatilization. An experimentally based, conceptual model of the devolatilization of a HV bituminous coal is outlined in this repair. This model contends that the relative dominance of a process type-chemical kinetic, heat transport, mass transport – varies with the extent of reaction for a given set of heating conditions and coal type and with experimental and with experimental conditions for a given coal types and extent of reaction. The relevant "reference" conditions of interest for direct utilization are rapid transient heating of small (< 100 micron) particles to temperatures of 1000°C or greater. The model postulatew that the overall rates of coal devolatilization should vary with coal type insofar as the characteristics of the parent coal determine the potential tar yield and the chemical characteristics of the initial tars. Experimental evidence indicates chemical characteristics and yields of "primary" tars vary significant with coal type. Consequently, the conceptual model would indicate a shift from transport to chemical dominance of rate processes with variation in coal types. Using the conceptual model, UTRC has been able to correlate initial mass loss with a heat transfer index for a wide range of conditions for high tar yielding coals. 33 refs., 30 figs., 6 tabs.

33628 (DOE/PC/70768–11) **Kinetics of coal pyrolysis and devolatilization: Technical progress report, August 1, 1987–October 31, 1987.** United Technologies Research Center, East Hartford, CT (United States). [1987]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70768. Order Number DE92000214. Source: OSTI; NTIS; GPO Dep.

The objective of these coordinated experimental and modeling studies is to develop an improved understanding of the kinetics of coal devolatilization which are relevant to suspension firing of powdered coal. Principal topics include: (a) the pyrolysis and devolatilization of coal; and (b) the formation of char. Research activities include small-scale experimentation, interpretation of experimental results in terms of mechanistic understanding and the development and validation of kinetic models of fundamental processes. This report presents results on the effect of coal rank on the chemical characteristics of the evolved tars and some results of a modeling effort on intraparticle heat transfer. The modeling study of intraparticle heat transfer has developed new indices for quantifying extent of "isothermally." These indices are valuable for determining the extent of agreement between volume averaged pyrolysis rates and the corresponding quantity calculated using the particle surface temperature for the entire volume. 8 refs., 11 figs., 1 tab.

33629 (DOE/PC/70768–12) **Kinetics of coal pyrolysis and devolatilization: Technical progress report, November 1, 1987–January 31, 1988.** United Technologies Research Center, East Hartford, CT (United States). [1988]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-84PC70768. Order Number DE92000216. Source: OSTI; NTIS; GPO Dep.

The objective of these coordinated experimental and modeling studies is to develop an improved understanding of the kinetics of coal devolatilization which are relevant to suspension firing of powdered coal. These fundamental kinetic studies address several topics related to an improved understanding of pulverized coal combustion and includes both homogeneous and heterogeneous reactions. The principal topics include: (a) the pyrolysis and devolatilization of coal; and (b) the formation of char. Research activities include small-scale experimentation, interpretation of experimental results in terms of mechanistic understanding and the development and validation of kinetic models of fundamental processes. 9 refs., 9 figs., 1 tab.

33630 (DOE/PC/79661–T9) **Development of a vortex combustor (VC) for space/water heating applications (cold flow modeling): Final report.** Nieh, S. Catholic Univ. of America, Washington, DC (United States). Combustion and Multiphase Flows Lab. Apr 1990. 251p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-87PC79661. Order Number DE91018314. Source: OSTI; NTIS; GPO Dep.

This report focuses on the discussion of cold flow measurements and mathematical modeling of the vortex combustor (VC). A parallel research project on the combustion tests of a 2-4 MB/H proof-of- concept VC has been conducted by the Naval Civil Engineering Laboratory. This final report is divided into seven chapters: Chapter 1 discusses the concept and advantages of the VC, and the technical approach to develop and demonstrate this VC concept. Chapter 2 describes in details the instrumentation and test apparatuses of the VC cold models. Chapters 3 and 4 discuss the measured results of gas flow field and particle flow field. Development and atomization tests of CWF nozzles are also presented in this chapter. Chapter 5 provides the basics governing equations and numerical methods for the five sub-processes in the VC. Chapter 6 gives the calculated results of validation tests of the computer program and the results of numerical simulation of the VC processes. Finally, Chapter 7 concludes the efforts of cold flow modeling study of the VC. 52 refs., 101 figs., 39 tabs.

33631 (DOE/PC/88913–T9) **Mechanics/heat-transfer relation for particulate materials [for July 1991]: [Quarterly report].** Campbell, C.S. University of Southern California, Los Angeles, CA (United States). Dept. of Mechanical Engineering. Jul 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88913. Order Number DE92000340. Source: OSTI; NTIS; GPO Dep.

The major emphasis this quarter has been in two areas. The first is to continue working the bugs out of the new particle pressure transducer. The second was to try and measure the particle pressures generated in a bed catalyst that is undergoing particulate fluidization. The results indicate that the stabilization of fluidized beds in that regime cannot be explained in terms of particle pressure generation. Instead, consistent with other recent observations, the observations can be explained by a material is that not completely fluidized but, instead, retains much of the properties of a solid and, in particular, can transmit particle pressure like a solid. Also, in this quarter, one of the author's students, David Wang, successfully defended his PhD thesis; his research was sponsored by this grant and concerned both the thermal conductivity measurements and the early work on particle pressures in fluidized beds. The particle pressure work was also presented at the ITEM Symposium on the Mechanics of Fluidized Beds, held at Stanford in the early part of this month.

33632 (DOE/PC/88937–T10) **Experimental studies on group ignition of a cloud of coal particles: Quarterly progress report**

**No. 11, February 16, 1991–May 15, 1991.** Annamalai, K.; Anand, V.; Ryan, W.; Kharbat, E. Texas A and M Univ., College Station, TX (United States). Dept. of Mechanical Engineering. [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-88PC88937. Order Number DE91018328. Source: OSTI; NTIS; GPO Dep.

Research on the ignition of a cloud of coal particles continued. This period, the cylindrical cloud model was used to obtain ignition results. The results are obtained for ignition time vs. coal number density. (CBS)

**33633** (DOE/PC/89776–T3) **Effects of calcium magnesium acetate on the combustion of coal-water slurries: Seventh quarterly project status report, 1 March 1991–31 May 1991.** Levendis, Y.A. Northeastern Univ., Boston, MA (United States). Dept. of Chemical Engineering. [1991]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-89PC89776. Order Number DE92000354. Source: OSTI; NTIS; GPO Dep.

The general objective of the project is to investigate the combustion behavior of single and multiple Coal-Water Fuel (CWF) particles burning at high temperature environments. Both uncatalyzed as well as catalyzed CWF drops with Calcium Magnesium Acetate (CMA) catalyst will be investigated. Emphasis will also be given in the effects of CMA on the sulfur capture during combustion. To help achieve these objectives the following project tasks were carried over this 7th three-month period: (1) Redesigning of the pyrometer electronics. (2) Theoretical analysis of the pyrometer limitations. (3) Production of predried CWF agglomerates with subsequent particle heating studies and (4) Construction and testing of an apparatus to fluidize and introduce many particles in the furnace. 12 figs., 1 tab.

**33634** (DOE/PC/90160–T2) **Advanced atomization concept for CWF burning in small combustors, Phase 2: Quarterly technical progress report No. 2, January 1, 1991–March 31, 1991.** Heaton, H.; McHale, E. Atlantic Research Nuclear Corp., Alexandria, VA (United States). [1991]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90160. Order Number DE91018324. Source: OSTI; NTIS; GPO Dep.

The present project involves the second phase of research on a new concept in coal-water fuel (CWF) atomization that is applicable to burning in small combustors. It is intended to address the single most important problem associated with CWF combustion; i.e., production of small spray droplets in an efficient manner by an atomization device. Phase 1 of this work was successfully completed with the development of a opposed-jet atomizer (described below) that met the goals of the first contract. Progress was made on Tasks 1, 2, 3 and 7, involving set-up of the prototype atomizer and preliminary testing; designing and ordering the PETC atomizer; identifying and ordering the Parker-Hannifin atomizer; and producing the bituminous CWF (Fuel A), respectively. Work on Tasks 4, 5 and 6 is expected to begin next quarter. There has been a delay in acquiring two items for the program – the Parker-Hannifin atomizer and the western bituminous coal for Fuel B. 1 fig.

**33635** (DOE/PC/90286–T2) **Combustion fume structure and dynamics.** Flagan, R.C. California Inst. of Tech., Pasadena, CA (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90286. Order Number DE91018612. Source: OSTI; NTIS; GPO Dep.

The focus of this research program is on elucidating the fundamental processes that determine the particle size distribution, composition, and agglomerate structures of coal ash fumes. The ultimate objective of this work is the development and validation of a model for the dynamics of combustion fumes, describing both the evolution of the particle size distribution and the particle morphology. The study employs model systems to address the fundamental questions and to provide rigorous validation of the models to be developed. This first phase of the project has been devoted to the development of a detailed experimental strategy that will allow agglomerates with a broad range of fractal dimensions to be studied in the laboratory. 7 refs.

**33636** (DOE/PC/90751–T9, pp. 2.1-2.5) **Introduction and overview of program tasks.** PSI Technology Co., Andover, MA (United States). May 1989. In *Transformations of inorganic coal constituents in combustion systems. Quarterly report No. 10 for the period January to March 1989.* 144p. Order Number DE91010549. Source: OSTI; NTIS.

This project consists of an integrated series of experimental and modeling tasks performed by PSI Technology Co. (PSIT) and five subcontractors (identified below) to achieve the project objectives. Important elements of this work include coal characterization using advanced analytical techniques, testing in small-scale reactors and combustors, modeling of fundamental processes by which mineral transformations occur, as well as incorporating an improved understanding of these processes into an engineering model to predict particle size and composition distributions. The project is divided into 8 tasks: (1) program planning, management, reporting, and peer review; (2) coal selection preparation and characterization; (3) advanced techniques for coal and mineral characterization; (4) fundamental studies of selected ash vaporization, nucleation, condensation, and coagulation phenomena; (5) fundamental studies of mineral matter vaporization and residual ash formation; (6) pulverized coal combustion studies of ash enrichment by volatiles and fragmentation; (7) idealized combustion determination of ash particle formation and surface stickiness; and (8) model development and integration.

**33637** (DOE/PC/90751–T9, pp. 4.1-4.11) **Task 4 - Fundamental studies of selected ash vaporization, nucleation, condensation, and coagulation phenomena.** Flagan, R.C. (California Inst. of Tech., Pasadena (USA)). PSI Technology Co., Andover, MA (United States). May 1989. In *Transformations of inorganic coal constituents in combustion systems. Quarterly report No. 10 for the period January to March 1989.* 144p. Order Number DE91010549. Source: OSTI; NTIS.

The specific objectives of this portion of the program are: (1) to develop a quantitative data base on ash thermochemistry for single component and multicomponent ash in combustion environments, and (2) to develop a fundamental understanding of the formation and growth of particles from the ash vapors, including the nucleation, condensation, coagulation, and coalescence processes. Research progress is described for: ash aerosol dynamics; ash volatilization; and aerosol measurement.

**33638** (DOE/PC/90751–T9, pp. 4.12-4.45) **Stokes drag on self-similar clusters of spheres.** Rogak, S.N. (California Inst. of Tech., Pasadena (USA)); Flagan, R.C. PSI Technology Co., Andover, MA (United States). May 1989. In *Transformations of inorganic coal constituents in combustion systems. Quarterly report No. 10 for the period January to March 1989.* 144p. Order Number DE91010549. Source: OSTI; NTIS.

Aggregation phenomena in gas and liquid phases often produce agglomerates that appear to be fractals in the sense that the cluster mass varies with the radius of gyration to a fractional power. The creeping (Stokes) flow around the cluster may be represented by the superposition of k single-sphere velocity fields chosen to satisfy the boundary conditions at k points on the cluster. Computations can be performed for large self-similar clusters of $k^n$ monomers by decomposing the cluster n times into smaller clusters which may be replaced by hydrodynamically equivalent spheres. The method recovers the correct results for chains, discs and compact clusters. Computations done on random, connected clusters similar to real aggregates show that both the primary particle diameter and the cluster radius influence the drag. The influence of the primary particle size and other small-scale structure features is lost very rapidly as the fractal dimension increases above 1.3 and the number of monomers in the cluster increases above 100.

**33639** (DOE/PC/90751–T9, pp. 5.1-5.53) **Task 5 - Fundamental studies of mineral matter vaporization and residual ash formation.** Kang, S.G. (M.I.T., Cambridge, MA (USA)); Sarofim, A.F. Beer, J.M. PSI Technology Co., Andover, MA (United States). May 1989. In *Transformations of inorganic coal constituents in combustion systems. Quarterly report No. 10 for the period January to March 1989.* 144p. Order Number DE91010549. Source: OSTI; NTIS.

During the past quarter, baseline experiments were performed at MIT with seven coals to obtain the baseline information for the mineral matter transformation during pulverized coal combustion.

These include Kentucky #9 (Ky9) and Upper Freeport (UF) bituminous coals, Eagle Butte (EB) subbituminous coal, Beulah (BL) and Texas (San Miguel) (TL) lignites, and Lochiel (LO) and Loy Yang (LY) Australian brown coals. Effort was also exerted on obtaining a better understanding of the developed fragmentation model. This report is composed of three sections. In the first section the authors discuss the SEM-AIA technique and the chemical analysis of the mineral matter in the coal. In the second section, they compare the seven coals with respect to their flyash formation behavior during pulverized coal combustion. In the last section, they present their recent work on the percolation model.

**33640** (DOE/PC/90751–T9, pp. 6.1-6.14) **Task 6 - Behavior and effects of coal mineral matter in laboratory pulverized coal combustor.** Gallagher, N.B. (Univ. of Arizona, Tucson (USA)); Bool, L.E. III; Wendt, J.O.; Peterson, T.W. PSI Technology Co., Andover, MA (United States). May 1989. In *Transformations of inorganic coal constituents in combustion systems. Quarterly report No. 10 for the period January to March 1989.* 144p. Order Number DE91010549. Source: OSTI; NTIS.

Baseline data from Beulah Lignite, Eagle Butte, Kentucky #9, and Illinois #6 coals are presented. Data consist of elemental analyses of size segregated samples of airborne ash, and emphasis is on the effects of coal composition on enrichment of various elements on various sized particles. Tests for the Kentucky #11 coal have also been performed, but ash analyses are not yet complete. In this Quarterly Report the authors present the data with only an incomplete interpretation. Samples have also been gathered for Auger analyses and XAFS for chemical species analyses. When these analyses become available, a more quantitative interpretation of the data will be possible.

**33641** (DOE/PC/90751–T9, pp. 7.1-7.16) **Task 7 and 8 - Idealized combustor studies and alkali kinetics modeling.** Helble, J.J. (PSI Technology Co., Handover, MA (USA)); Srinivasachar, S.; Boni A.A. PSI Technology Co., Andover, MA (United States). May 1989. In *Transformations of inorganic coal constituents in combustion systems. Quarterly report No. 10 for the period January to March 1989.* 144p. Order Number DE91010549. Source: OSTI; NTIS.

At PSIT, detailed alkali kinetic modeling was conducted. Rate constants for the Na/Cl/S/O/H systems were obtained from the literature and the SCCOFF code from the State Electricity Commission of Victoria. Several rate coefficients in SCCOFF were updated to better reflect values reported in the open literature. Calculations were performed using the CHEMKIN chemical kinetics package with the aforementioned rates and compared to partial equilibrium predictions. It was found that in both chlorinated and nonchlorinated systems, predicted concentration levels rapidly approached partial equilibrium values (i.e., gas phase equilibrium without allowance for condensed phase species) for sodium chloride and sodium hydroxide, the two dominant sodium species. Sodium sulfate was not predicted to occur in the vapor phase. A detailed description of these calculations was prepared for presentation at the 197th ACS Meeting in Dallas in mid-April and will be included in the next Quarterly Report. In the experimental category, chemical data analysis was completed for experiments conducted previously with the Kentucky #11 and N.D. Beulah lignite coals. Utilizing modifications of software developed at the University of Kentucky, CCSEM data for various size classes of ash particles were examined for composition trends. For the two coals in question, it was found that chemical composition did not vary significantly with particle size. Calcium in the Beulah lignite provides a possible exception, as it appears to coat most residual ash particles, with higher concentrations found in the smaller particles. Sectioning of these ash particles is planned for the upcoming quarter to examine this effect in greater detail.

### 0150 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 33614, 33667, 34371*

**33642** (DOE/EIA–0118(90)) **Coal Production 1990.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 12 Sep 1991. 136p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018995. Source: OSTI; NTIS; GPO; GPO Dep.

This report provides comprehensive information about US coal production, the number of mines, prices, productivity, employment, and reserves to a wide audience including Congress, Federal and State agencies, the coal industry, and the general public. This report also includes data for the demonstrated reserve base of coal in the United States on January 1, 1991. This is the 11th annual summary on minable coal, pursuant to Section 801 of Public Law 95-620, the Powerplant and Industrial Fuel Use Act of 1978. 9 figs., 32 tabs.

### 0160 Health and Safety

**33643** (CONF-900859–, pp. 482-494) **Equipment for coal dust sampling.** Ghim, Young Sung (Korea Institute of Energy and Resources, Daejeon (Korea)); Park, Young Ok; Koo, Cheol Oh; Son, Jae Ek. USDOE Pittsburgh Energy Technology Center, PA (United States); Korea Inst. of Energy and Resources, Daeduk (Korea, Republic of). [1990]. From 7. U.S.-Korea workshop on coal utilization technology meeting: Pittsburgh, PA (United States); 26-29 Aug 1990. In *7th US-Korea joint workshop on coal utilization technology. Proceedings.* 589p. Order Number DE91012801. Source: OSTI; NTIS.

Samples for airborne coal dust have been taken for over one hundred years. Current methods and regulations provide for a systematic and repeatable way to generate samples. This paper will discuss the regulations and equipment which is currently available. Respirable coal dust sampling equipment must meet both MSHA and NIOSH specifications. These specifications insure reliable data and electrical safety. Many quality control checks are made before coal operators receive the sampling equipment. Some of these checks are also described.

## 02 PETROLEUM

### 0202 Reserves, Geology, and Exploration

**33644** (DOE/BC/14434–4) **Depositional sequence analysis and sedimentologic modeling for improved prediction of Pennsylvanian reservoirs: Quarterly report, January–March 1991.** Watney, W.L. Kansas Geological Survey, Lawrence, KS (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90BC14434. Order Number DE92000265. Source: OSTI; NTIS; GPO Dep.

The objectives of this research are to: (1) assist producers in locating and producing petroleum not currently produced because of technological problems or the inability to identify details of reservoir compartmentalization, (2) to decrease risk in field development, and (3) accelerate the retrieval and analysis of baseline geoscience information for initial reservoir description. The interdisciplinary data sought in this research will be used to resolve specific problems in correlation of strata and to establish the mechanisms responsible for the Upper Pennsylvanian stratigraphic architecture in the Midcontinent. The data will better constrain ancillary problems related to the validation of depositional sequence and subsequence correlation, subsidence patterns, sedimentation rates, sea-level changes, and the relationship of sedimentary sequences to basement terrains. The geoscientific information, including data from field studies, surface and near-surface reservoir analogues, and regional database development, will also be used for development of geologic computer process-based simulation models tailored to specific depositional sequences for use in improving prediction of reservoir characteristics. 4 refs.

**33645** (DOE/BC/14448–6) **Ourcrop characterization of sandstone heterogeneity in Carboniferous reservoirs, Black Warrior basin, Alabama.** Pashin, J.C.; Osborne, E.W.; Rindsberg, A.K. Geological Survey, Tuscaloosa, AL (United States). Aug 1991. 126p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90BC14448. Order Number DE91017217. Source: OSTI; NTIS; GPO Dep.

Where production is currently declining, improved recovery strategies, such as waterflooding, injection, strategic well placement, and infill drilling may be used to increase production of liquid hydrocarbons from reservoir sandstone in the Black Warrior basin. Characterizing reservoir heterogeneity provides information regarding how those strategies can best be applied, and exceptional exposures of asphaltic sandstone in north Alabama enable first-hand observation of such heterogeneity. This report identifies heterogeneity in Carboniferous strata of the Black Warrior basin on the basis of vertical variations, lithofacies analysis. Results of lithofacies analysis and depositional modeling were synthesized with existing models of sandstone heterogeneity to propose methods which may improve hydrocarbon recovery in Carboniferous sandstone reservoirs of the Black Warrior basin. 238 refs., 89 figs. 2 tabs.

**33646** (DOE/BC/14473–6) **Demonstration of high-resolution inverse VSP for reservoir characterization applications: Quarterly report, January–March 1991.** Parra, J.O. Southwest Research Inst., San Antonio, TX (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-89BC14473. Order Number DE92000266. Source: OSTI; NTIS; GPO Dep.

The objective of this project is the determination of inverse vertical seismic profiling (VSP) measurements using new experimental field instrumentation capable of providing at least an order of magnitude improvement in the resolution of structural details in comparison with conventional seismic images. This two-year project will entail instrumentation tests under controlled field conditions during the first year followed by full-scale field demonstration tests in a representative oil-bearing reservoir formation during the second year. An automatic time-picking program and a tomographic inversion program developed for processing interwell seismic data were generalized for processing reverse VSP data. A technical paper was submitted for publication to Geophysics. The paper is entitled; "A Wax-Embedded Borehole Seismic Detector for High-Resolution Measurements." A copy of this manuscript is enclosed in the Appendix. 3 figs., 1 tab.

**33647** (DOE/BC/14653–2) **Innovative techniques for the description of reservoir heterogeneity using tracers: Quarterly report, January–March 1991.** Pope, G.; Sepehrnoori, K. Texas Univ., Austin, TX (United States). Dept. of Petroleum Engineering. Sep 1991. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90BC14653. Order Number DE92000274. Source: OSTI; NTIS; GPO Dep.

The objective of this research is to develop an advanced, innovative technique for the description of reservoir heterogeneity. This proposed method consists of using tracers in single-well backflow tests. The general idea is to make use of fluid drift in the reservoir either due to naturally occurring pressure gradients in the reservoir, or by deliberately imposed pressure gradients using adjacent injection and production wells in the same reservoir. The analytical tool that will be used to design and interpret these tests is a compositional reservoir simulator with special features added and tested specifically for this purpose. 2 refs., 5 figs.

**33648** (DOE/BC/14658–3) **Predictability of formation damage: An assessment study and generalized models: Quarterly report, January–March 1991.** Civan, F. Oklahoma Univ., Norman, OK (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90BC14658. Order Number DE92000270. Source: OSTI; NTIS; GPO Dep.

The project objective is to develop improved generalized predictive models to be used for investigation of reservoir formation damage and control for various fluid and rock conditions and to account for these effects in reservoir simulation. To accomplish its objective the proposed study will first critically study and evaluate the previous modeling efforts and the experimental studies reported in the literature. Then, generalized predictive models will be formulated by combining the previous attempts and by improving and generalizing the modeling approaches to accommodate for a wide variety of conditions encountered in actual field applications. A critical review of the previous work addressing their theoretical basis, assumptions and limitations, and the generalized and improved model developed in this study will be presented in a systematic manner in terms of a standardized definition and nomenclature for direct comparison. Case studies with the generalized model will be presented to demonstrate its capacity and validity. User friendly computer programs implementing the improved modeling approaches will also be supplied. This study will form an assessment of the presently available models and methods for evaluating and predicting formation damage and present improved models. Therefore, it will be an important reference for the petroleum industry. 1 tab.

**33649** (DOE/BC/14666–4) **Development of luminescent bacteria as tracers for geological reservoir characterization: Quarterly report, January–March 1991.** King, J.W. Hardin-Simmons Univ., Abilene, TX (United States). Fairleigh Dickinson Labs. [1991]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90BC14666. Order Number DE92000267. Source: OSTI; NTIS; GPO Dep.

This research project resulted from recognizing the problem of being unable to accurately distinguish communication between wells in producing oil zones which may or may not be continuous. Such a determination is necessary when considering Enhanced Oil Recovery (EOR) whether it is water flooding, carbon dioxide, or other methods which increase the sweep efficiency. Various kinds of chemical tracers are available, but they are expensive and many might be considered hazardous for underground aquifers. Other biological tracers are available, but have never been developed for oil reservoir conditions. Bioluminescent bacteria seemed an obvious candidate because they thrive in saline waters (usually 3% salt) which have been contaminated by oil spills.

**33650** (DOE/METC–91/6117, pp. 162-184) **Exploration for deep source hydrocarbons in subduction terrain of the Pacific Northwest.** Westhusing, K. (Dept. of Energy, Laramie, WY (USA)); Krehbiel, S. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Vibroseis reflection profiles and dynamite shot records were collected in 1988, 1989, and 1990 in southern Washington from surveys across the Southern Washington Cascade Conductor (SWCC), a conductivity anomaly postulated to be associated with marine sedimentary rocks that have been carried into the subsurface by a subduction zone active in the Eocene. Approximately 238 km of seismic survey lines were collected traversing the SWCC in an east-to-west direction, and with one survey extending north in the interior of the anomaly. Surveys were done to assess the petroleum potential and possible deep source origins of the petroleum that could be related to the subduction of the accretionary prism sediments. This report relates the results of exploration in the area and provides interpretations for the seismic sections in an effort to define the area's petroleum potential. Major structural features, such as the Morton and Skate Creek anticlines, could act as hydrocarbon traps; however, adequate source and reservoir rocks are undefined. Further seismic surveys were carried out in the summer of 1990 in an attempt to define the subducting layer and its associated sediments. Additional geologic mapping and well analyses were also accomplished to evaluate the complex subsurface geology. These data have yet to be processed, and the integrated assessment of the petroleum potential for the region must await the new seismic section's processing and interpretation, which is expected to be completed by mid-year 1991.

**33651** (DOE/METC–91/6117, pp. 197-204) **Kinetic models of hydrocarbon generation.** Burnham, A.K. (Lawrence Livermore National Lab., CA (USA)); Sweeney, J.J. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The authors are carrying out an integrated program of laboratory experiments, kinetic modeling, and basin thermal history modeling

in order to better understand the natural breakdown of organic matter into oil and gas. Kinetic models of organic maturation are being used to better understand the coupling of generation, cracking, expulsion, and overpressuring in both the laboratory and geologic setting. Currently they are carrying out chemical experiments and developing more efficient chemical kinetic modeling schemes to obtain a better understanding of explusion and cracking from lean source rocks and from hydrogen-poor (terrestrial) organic source material. They verify the chemical kinetic models by integrating them with thermal history models of hydrcarbon-producing sediments and comparing predicted and observed characteristics of the hydrocarbon occurrence in a variety of settings. They intend to apply this approach to evaluate the potential for deep gas resources in the Pacific Northwest and in the Louisiana Gulf Coast. Results to date are discussed.

33652 (DTH-LET-RE--90-7) **The effect of the number of pseudocomponents used in simulating MCM-displacements in heterogeneous reservoirs.** Kossack, C.A. (Division of Petroleum Engineering, Norwegian Institute of Technology (NO)); Moraeus Hanssen, M.; Olsen, H.; Reffstrup, J. Trondheim Univ. (Norway). Norges Tekniske Hoegskole; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik; Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark). Aug 1990. 108p. Order Number DE92703859. Source: OSTI; NTIS (US Sales Only).

The reservoir oil-injection gas system was described successfully using 4 hydrocarbon pseudo components + Nitrogen. Lumping from 15 components down to 5 components (including Nitrogen) was carried out in either one or two steps. Both of the reduced systems required regression to match the bubble-point pressure, the Nitrogen swelling experiment and the single flash GOR. Differential liberation experiments were only moderately well matched due to low weights in the regression procedure. The effect of heterogeneities in the given system is as follows. One-dimensional slimtube experiments or simulators are poor indicators of performance in a three-dimensional, heterogeneous reservoir. The correlation length of the heterogeneities determines the dominating displacement mechanism. The correlation length of the heterogeneties is proportional to the uncertainty in predicting recovery for a given stochastic reservoir. Small heterogeneities always have a negative influence on recovery due to additional microscaled dispersion. The uncertainty in predicted recovery due to unknown permeability distribution between wells is approximately +2/-5 % of STOIIP. The influence of large heterogeneities and homogeneous layers depends mainly on the vertical distribution of the permeabilities. The uncertainty in predicted recovery approximately +- 10% of STOIIP. The influence of well block permeability distributions is large. Phase behaviour is not a dominating displacement mechanism. The gravity and the vertical permeability distribution dominate the displacement. (AB) 26 refs.

33653 (NEI-DK--642) **Project "Dybseis": Deep seismic studies in the Jameson Land basin.** Marcussen, C.; Larsen, H.C. Groenlands Geologiske Undersoegelse, Copenhagen (Denmark). May 1991 40p. Contract EM-1313/88-3. Order Number DE92703895. Source: OSTI; NTIS (US Sales Only).

EFP-88.

During project DYBSEIS approximately 550 km of exploration seismic data were processed to 12 sec. The data quality below 6 sec. proved to be excellent. Interpretation of the deep-seismic data contributed considerably to the interpretation of the basement structure and early infill pattern. Furthermore, the data revealed the structure of the crust and upper mantle. Based mainly on the interpretation of the deep-seismic data, a modified simple shear model has been proposed for the development of the Jameson Land basin. Finally, a subsidence curve at the basin axis has been constructed providing a good background for basin modelling. (author) 16 refs.

33654 (SAND--91-0980C) **Electromagnetic oil field mapping for improved process monitoring and reservoir characterization.** Waggoner, J.R.; Mansure, A.J. Sandia National Labs., Albuquerque, NM (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911125--1: 3. international reservoir characterization technical conference, Tulsa, OK (United States), 3-5 Nov 1991). Order Number DE91017452. Source: OSTI; NTIS; GPO Dep.

Electromagnetic (EM) techniques are being developed to monitor oil recovery processes and improve overall process performance. Just as seismic surveys generate acoustic waves to detect changes in sonic velocity, and then infer rock properties, EM surveys generate electromagnetic fields to detect changes in electrical resistivity, and then infer fluid properties. The potential impact of the EM survey is very significant, primarily in the areas of locating oil, identifying oil inside and outside the pattern, characterizing flow units, and pseudo-real time process control to optimize process performance and efficiency. Since a map of resistivity is of no direct use to a reservoir engineer, an essential part of the EM technique is understanding the relationship between the process and the formation resistivity at all scales, and integrating this understanding into reservoir simulation. This abstract discusses the process we have developed for integrating EM measurements into reservoir characterization and simulation. 4 refs., 1 fig.

33655 (SAND--91-1104) **The depth of the oil/brine interface and crude oil leaks in SPR caverns.** Heffelfinger, G.S. Sandia National Labs., Albuquerque, NM (United States). Jun 1991. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91017219. Source: OSTI; NTIS; GPO Dep.

Monitoring wellhead pressure evolution is the best method of detecting crude oil leaks in SPR caverns while oil/brine interface depth measurements provide additional insight. However, to fully utilize the information provided by these interface depth measurements, a thorough understanding of how the interface movement corresponds to cavern phenomena, such as salt creep, crude oil leakage, and temperature equilibration, as well as to wellhead pressure, is required. The time evolution of the oil/brine interface depth is a function of several opposing factors. Cavern closure due to salt creep and crude oil leakage, if present, move the interface upward. Brine removal and temperature equilibration of the oil/brine system move the interface downward. Therefore, the relative magnitudes of these factors determine the net direction of interface movement. Using a mass balance on the cavern fluids, coupled with a simplified salt creep model for closure in SPR caverns, the movement of the oil/brine interface has been predicted for varying cavern configurations, including both right-cylindrical and carrot-shaped caverns. Three different cavern depths and operating pressures have been investigated. In addition, the caverns were investigated at four different points in time, allowing for varying extents of temperature equilibration. Time dependent interface depth changes of a few inches to a few feet were found to be characteristic of the range of cases studied. 5 refs, 19 figs., 1 tab.

## 0203 Drilling and Production

*Refer also to citation(s) 33647, 33649*

33656 (DOE/BC/10842--19) **Flow in porous media, phase and ultralow interfacial tensions: Mechanisms of enhanced petroleum recovery: Final report.** Davis, H.T.; Scriven, L.E. Minnesota Univ., Minneapolis, MN (United States). Dept. of Chemical Engineering and Materials Science. Jul 1991. 295p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-85BC10842. Order Number DE91002247. Source: OSTI; NTIS; GPO Dep.

A major program of university research, longer-ranged and more fundamental in approach than industrial research, into basic mechanisms of enhancing petroleum recovery and into underlying physics, chemistry, geology, applied mathematics, computation, and engineering science has been built at Minnesota. The original focus was surfactant-based chemical flooding, but the approach taken was sufficiently fundamental that the research, longer-ranged than industrial efforts, has become quite multidirectional. Topics discussed are volume controlled porosimetry; fluid distribution and transport in porous media at low wetting phase saturation; molecular dynamics of fluids in ultranarrow pores; molecular dynamics and molecular theory of wetting and adsorption; new numerical methods to handle initial and boundary conditions in immiscible

displacement; electron microscopy of surfactant fluid microstructure; low cost system for animating liquid crystallites viewed with polarized light; surfaces of constant mean curvature with prescribed contact angle.

**33657** (DOE/BC/14202–5) **Microbial enhancement of oil production from carbonate reservoirs: Quarterly report, January–March 1991.** Tanner, R.S.; Knapp, R.M.; McInerney, M.J.; Udegbunam, E.O. Oklahoma Univ., Norman, OK (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90BC14202. Order Number DE92000276. Source: OSTI; NTIS; GPO Dep.

The goal of this work is to evaluate the potential for Microbial Enhanced Oil Recovery (MEOR) in carbonate reservoirs. Specific objectives include: review of the literature pertinent to MEOR in carbonate reservoirs, a study of the microbial ecology of carbonate reservoirs, isolation of microorganisms and their end-products of metabolism on carbonate pore structure, the recovery of residual oil from carbonates in model core systems, and development of models to examine and predict MEOR processes in carbonate reservoirs. 1 ref., 3 figs., 1 tab.

**33658** (DOE/ID–10326) **Microbial enhanced oil recovery and wettability research program: Annual report, FY 1990.** Thomas, C.P.; Bala, G.A.; Duvall, M.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jul 1991. 131p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91002248. Source: OSTI; NTIS; GPO Dep.

This report covers research results for the microbial enhanced oil recovery (MEOR) and wettability research program conducted by EG&G Idaho, Inc. at the Idaho National Engineering Laboratory (INEL). The isolation and characterization of microbial species collected from various locations including target oil field environments is underway to develop more effective oil recovery systems for specific applications. The wettability research is a multi-year collaborative effort with the New Mexico Petroleum Recovery Research Center (NMPRRC), to evaluate reservoir wettability and its effects on oil recovery. Results from the wettability research will be applied to determine if alteration of wettability is a significant contributing mechanism for MEOR systems. Eight facultatively anaerobic surfactant producing isolates able to function in the reservoir conditions of the Minnelusa A Sands of the Powder River Basin in Wyoming were isolated from naturally occurring oil-laden environments. Isolates were characterized according to morphology, thermostability, halotolerance, growth substrates, affinity to crude oil/brine interfaces, degradative effects on crude oils, and biochemical profiles. Research at the INEL has focused on the elucidation of microbial mechanisms by which crude oil may be recovered from a reservoir and the chemical and physical properties of the reservoir that may impact the effectiveness of MEOR. Bacillus licheniformis JF-2 (ATCC 39307) has been used as a benchmark organism to quantify MEOR of medium weight crude oils (17.5 to 38.1°API) the capacity for oil recovery of Bacillus licheniformis JF-2 utilizing a sucrose-based nutrient has been elucidated using Berea sandstone cores. Spacial distribution of cells after microbial flooding has been analyzed with scanning electron microscopy. Also the effect of microbial surfactants on the interfacial tensions (IFT) of aqueous/crude oil systems has been measured. 87 refs., 60 figs., 15 tabs.

**33659** (DOE/S–0088P) **National Energy Strategy: Technical Annex 4, Barriers to the use of horizontal drilling technology.** USDOE Office of the Secretary, Washington, DC (United States). [1991]. 43p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018506. Source: OSTI; NTIS; GPO Dep.

Horizontal well drilling is one of the most important technological developments in the oil industry in this decade. The convergence of technology and experience has made horizontal drilling an important tool for increasing recovery of reserves by drilling new wells, recompleting existing wells, and contributing to secondary and tertiary recovery operations. When horizontal technology is successful, it results not only in increased recoverable reserves but also in increased well spacing (and thus fewer wells), less surface environmental damage, faster payouts, lower finding and development costs, and higher after-tax rates of return. Since the early 1980's, operators have used horizontal drilling to improve production from more than 800 oil and gas wells throughout the world. The number of long-radius horizontal holes is increasing at a rate of more than 200 percent per year. The major issue in this analysis is whether there are significant barriers to developing and using horizontal drilling technology. Some parties contend that horizontal drilling technology and information are not available to all companies that want to apply it in the field, but others state that the only impediments to wider use of horizontal drilling are decades-old State drilling rules and regulations, intended for application to vertical wells. A related question addressed in this analysis is, how much government intervention in the marketplace is needed to accelerate the use of this technology? The main conclusions of this analysis are that market forces are working efficiently in horizontal drilling technology development and transfer, but that some existing drilling rules and regulations constitute barriers to wider use of this technology. 9 figs., 3 tabs.

**33660** (EGG-M–91102) **Surfactant based enhanced oil recovery mediated by naturally occurring microorganisms.** Thomas, C.P.; Bala, G.A.; Duvall, M.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1991]. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9110149–3: 66. annual Society of Petroleum Engineers (SPE) technical conference and exhibition, Dallas, TX (United States), 6-9 Oct 1991). Order Number DE91018747. Source: OSTI; NTIS; GPO Dep.

Oil recovery experiments using Bacillus licheniformis JF-2 and a sucrose based nutrient were performed using Berea sandstone cores ranging in permeability from 85 to 510 md [0.084 to 0.503 $\mu m^2$]. Bacillus licheniformis JF-2, a surfactant producing microorganism isolated from an oilfield environment, is nonpathogenic and will not reduce sulfate. Oil recovery efficiencies ($E_r$) for four different crude oils ranging from 19.1 to 38.1°API [0.9396 to 0.8343 g/cm$^3$] varied from 2.8 to 42.6% of the waterflood residual oil. Injection of "cell-free" supernatants resulted in $E_r$ values from 7.0 to 16.4%. Microbially-mediated systems reduced interfacial tension (IFT) about 20 mN/m for four different crude oils. Following microbial flood experimentation microorganisms were distributed throughout the core (110 md [0.109 $\mu m^2$] Berea sandstone) with a predominance of cells located near the outlet end. 34 refs., 6 figs., 7 tabs.

**33661** (NIPER–508) **Microbial enhanced waterflooding pilot project, Mink Unit, Delaware-Childers (OK) field.** Bryant, R.S.; Burchfield, T.E.; Dennis, D.M.; Hitzman, D.O. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Aug 1991. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE91002252. Source: OSTI; NTIS; GPO Dep.

The first microbial-enhanced waterflood field project was initiated in October of 1986. The site selected for the project is in the Mink Unit of Delaware-Childers field in Nowata County, Oklahoma. The pilot area consists of four adjacent inverted five-spot patterns drilled on 5-acre spacing. There are 21 injection and 15 production wells on this pilot. Four of the 21 injection wells were treated with microbial formulation. Laboratory screening criteria were developed to evaluate microorganisms for this project. Several different microbial formulations were tested. Injectivity and microbial field survivability tests were conducted during the baseline period on two off-pattern wells, and a chemical tracer, fluorescein, was injected into the four injection wells during the baseline period. Methodologies for field applications of microorganisms in ongoing waterfloods were developed as a result of this project. Results from the field pilot showed that microorganisms could be injected into an ongoing waterflood without causing any problems in injectivity. Microbial treatment did improve oil production rate, and water/oil ratios for producing wells nearest the microbially treated injection wells continue to be more favorable than baseline values. 23 refs., 30 figs., 28 tabs.

**33662** **Bottom hole blowout preventer.** Lineham, D.H. 24 Apr 1991. Filed date 24 Oct 1989. Canada Patent patent application 2001387. 17p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An automatically controlled ball-valve type bottom-hole blowout preventer is provided for use in drilling oil or gas wells. The

blowout preventer of the invention operates under normal drilling conditions in a fully open position with an unrestricted bore. This condition is maintained by a combination of spring and mud flow pressure acting against the upper surfaces of the valve. In the event of a well kick or blowout, pressures from gas or fluid volumes acting against the lower surfaces of the valve force it into the fully closed position. A system of ports and check valves within the blowout preventer forces hydraulic fluid from one chamber to another. The metering effect of these ports determines the rate of closure of the valve, thereby allowing normal running and pulling of the drill string or tubing, without interference to pipe fill-up or drainage, from valve closure. The blowout preventer is placed in a subassembly that is an integral part of the drill string and can be incorporated in a string in any location. 3 figs.

## 0204 Processing

*Refer also to citation(s) 33674, 34550, 34728*

## 0207 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 34260, 34371*

33663 (DOE/EIA–0109(91/09)) **Petroleum supply monthly, September 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 30 Sep 1991. 145p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000613. Source: OSTI; NTIS; GPO; GPO Dep.

The Petroleum Supply Monthly (PSM) is one of a family of three publications produced by the Petroleum Supply Division within the Energy Information Administration (EIA) reflecting different levels of data timeliness and completeness. The other two publications are the Weekly Petroleum Status Report (WPSR) and the Petroleum Supply Annual (PSA). Data presented in PSM describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administrations for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 states and the District of Columbia). The reporting universe includes those petroleum sectors in Primary Supply. Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into two sections (1) the Summary Statistics and (2) the Detailed Statistics. 65 tabs.

33664 (DOE/EIA–0380(91/09)) **Petroleum marketing monthly, September 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. 16 Sep 1991. 201p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018972. Source: OSTI; NTIS; GPO; GPO Dep.

This publication is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the f.o.b. and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented. 53 refs., 12 figs., 55 tabs.

33665 (DOE/EIA–0520(91/09)) **International petroleum statistics report, September 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 2 Oct 1991. 60p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000612. Source: OSTI; NTIS; GPO; GPO Dep.

The International Petroleum Statistics Report is a monthly publication that provides current international oil data. This report is published for the use of members of Congress, federal agencies, state agencies, industry, and the general public. Publication of this report is in keeping with responsibilities given the Energy Information Administration in Public Law 95-91 (Section 205(a)(2)). The International Petroleum Statistics Report presents data on international oil production, consumption, imports, exports, and stocks. The report has three sections. Section 1 contains time series on world oil production, and on oil consumption and stocks in the Organization for Economic Cooperation and Development (DECD). This section contains annual data beginning in 1973, and monthly data for the most recent two years. Section 2 presents an oil supply/consumption balance for the market economies (i.e. noncommunist countries). This balance is presented in quarterly intervals for the most recent two years. Section 3 presents data on oil imports by DECD countries. This section contains annual data beginning in 1982, and quarterly data for the most recent two years. 41 tabs.

33666 (DOE/EIA–0523(90/4Q)) **International oil and gas exploration and development activities: Quarterly report, October–December 1990.** USDOE Energy Information Administration, Washington, DC (United States). Office of Oil and Gas. Sep 1991. 53p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018914. Source: OSTI; NTIS; GPO; GPO Dep.

This report is part of an ongoing series of quarterly publications that monitors discoveries of oil and natural gas in foreign countries and provides an analysis of the resulting reserve additions. The report is prepared by the Energy Information Administration (EIA) of the US Department of Energy (DOE) under the Foreign Energy Supply Assessment Program (FESAP). Presented is summary of discoveries and reserve additions that result from recent international exploration and development activities. A discovery, as used in this publication, is a published estimate of the ultimately recoverable reserves for either a new field, reservoir, or well. Ultimate recovery is defined in this report as cumulative production plus remaining plus reserves. Discoveries are obtained from various oil industry periodicals and company annual or quarterly reports. The discoveries are not verified by EIA but simply restated in this publication. There are four tables and six figures showing oil production, oil and gas reserve additions, active rotary rigs, and crude oil prices. The data are presented by country, geographic region, or economic sector such as the Organization of Petroleum Exporting Countries (OPEC), the Non-OPEC Market Economics (Non-OPEC ME), and the Centrally Planned Economies (CPE). A few of the more significant discoveries are discussed in this report, and their approximate locations are shown on three continental maps. The appendices list discoveries reported in industry periodicals and company reports, Petroconsultants oil and gas reserve additions, remaining oil and gas reserves, and a glossary of abbreviations. 19 refs., 7 figs., 4 tabs.

33667 (DOE/EIA–0543(91/2Q)) **US energy industry financial developments: 1991 Second quarter.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. Sep 1991. 22p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018631. Source: OSTI; NTIS; GPO; GPO Dep.

Net income for the 226 energy companies included in this report was 14 percent lower than in the second quarter of 1990. Declining income from refining/marketing operations, chemical operations, natural gas production, and coal operations resulted in a 22 percent fall in income for fossil fuel companies. The other category of energy companies included in this report – rate-regulated utilities – recorded a 1 percent decline in income. Income from 18 majors petroleum companies' domestic refining/marketing operations fell 68 percent, while foreign refining/marketing income declined a lesser 12 percent. A relatively greater reliance upon oil production as a source of income on the part of the majors helped offset the negative effects of unusually low natural gas prices during the quarter. Independent refining/marketing companies experienced a 43 percent decline in income during the second quarter of 1991. The financial performance of these companies reflected the effects of lower refined product demand and decreased refining margins. Independent producers are much more reliant upon natural gas

production as a source of income than the majors. Income from the majors' coal operations declined 38 percent, while independent coal producers reported an income decline of 28 percent in the second quarter of 1991. Both declines were the result of reduced coal production and slightly lower coal prices. Oil field companies reported a 16 percent increase in income. A decline in Mideast and US drilling activity was partially offset by gains in European and Latin American areas. Although a number of US oil field companies are under contract to help rebuild the Kuwaiti oil fields, current financial results were not affected by the activities. 5 figs., 4 tabs.

**33668** (P–300-91-019) **[California Energy Commission] quarterly oil report, first quarter 1991: Volume 11, No. 1.** California Energy Commission, Sacramento, CA (United States). Jul 1991. 49p. Sponsored by California Energy Resources Conservation and Development Commission, Sacramento, CA (United States). Source: OSTI; CEC, Publications Unit, 1516 Ninth Street-MS13, Sacramento, CA 95814.

The total volume of petroleum fuels supplied in the first quarter of 1991 declined 5 percent (7.4 million barrels) from a year ago and 0.6 percent (0.9 million barrels) from the previous quarter. Unleaded gasoline volumes supplied were 2.6 percent (1.7 million barrels) higher in the first quarter than a year ago. Aviation fuel volumes supplied in the first quarter were 3.6 percent (0.8 million barrels) higher than a year ago. Distillate fuel volumes supplied in the first quarter were 5.2 percent (1.2 million barrels) lower than a year ago. Low sulfur fuel oil volumes supplied in the first quarter were 68 percent (2.9 million barrels) lower than a year ago. Electric utility use was 88 percent (2.9 million barrels) lower than a year ago. Petroleum fuel stocks were 4 percent (2.4 million barrels) higher than a year ago and 1.4 percent (0.8 million barrels) higher than the previous quarter. The average international crude oil price in the first quarter of 1991 was $18.43 per barrel, 1.1 percent higher than a year ago, but 37 percent below the previous quarter. The California Kern River average crude oil price in the first quarter of 1991 was $12.41 per barrel, 21 percent lower than a year ago and 43 percent lower than the previous quarter. Self-serve retail gasoline prices in the first quarter of 1991 were 12 to 17 percent higher than a year ago. Refiners produced an average of 2 million barrels of petroleum products per day in the first quarter of 1991, 6 percent less than a year ago and 3.5 percent less than the previous quarter. The statewide refinery utilization rate was 84.9 percent in the first quarter of 1991, down from 86.7 percent in the previous quarter and 95.2 percent from a year ago. 19 figs. 13 tabs.

## 0208 Waste Management

*Refer also to citation(s) 33670, 33675, 33676*

## 0220 Transport, Handling, and Storage

*Refer also to citation(s) 33671, 33673*

**33669** (BNL–52284, pp. 137-145) **Biological and stability problems in fuel storage systems.** Chesneau, H. (Fuel Quality Services, Buford, GA (USA)). Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

This paper discusses changes in fuel oil quality and its effect on biolgical and stability problems in fuel storage systems. Topics include fuel oil quality, particulates and sludges, water, microorganisms, biocides, prevention of microorganism growth, corrosion, instrumentation, corrective actions and case studies/examples of contamination and problems caused by it.

## 0230 Properties and Composition

**33670** (BNL–52284, pp. 77-105) **Fuel sulfur content, sulfur-oxide emission and corrosion in oil heating plants.** Farago, Z. (German Aerospace Research Establishment, Hardthausen (West Germany)). Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

Although less than one tenth of the global sulfur emission originates from domestic heating, this portion increases to 50-100% during the winter months in overcrowded European regions. Therefore, both the further reduction of the domestic oil sulfur content and the flue gas desulfurization for domestic heating are important determinants for the improvement of the air quality in built-up areas. In this paper, a method is introduced to predict the concentration of sulfur-trioxide, the water and the acidic dewpoint of the flue gas as a function of the oil sulfur level and the usual parameters of combustion. Calculation results of the corrosion rate in condensing heat exchangers are discussed. Possible operating conditions are described to reduce corrosion in heating plants and in condensing heat exchangers.

**33671** (BNL–52284, pp. 123-136) **Fuels, fuel quality, and storage.** Coughlan, R.T. Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

The quality of middle distillates, including No. 2 fuel oil, has been a topic of growing interest among the residential heating fuel industry. Over the past several years, concerns have been raised with regard to the current and future quality of home-heating fuel. Workshop discussions in past Oil Heat Technology Conferences, held at Brookhaven National Laboratory, have raised many questions regarding this topic. Fuel problems related to poor cold weather handling characteristics, sludge buildup in storage tanks, microbiological proliferation, and increased service needs of fuel delivery components, are cited as too frequent occurrences each heating season. Some concerns have also been expressed that the quality of fuel received downstream of the refinery lacked any consistency. This brings into question the practical usefulness of current ASTM fuel oil specifications, which give wide latitude to what can lawfully be sold as grade No.2 fuel oil. The strong interest in these issues, heightened by the likelihood that fuel quality may decrease in the future, formed the basis for a new study within BNL's Combustion Equipment Technology program in the area of Fuels, Fuel Quality, and Storage. The current objectives of the study are as follows: to present a broad view of factors that have brought about changes in distillate fuel quality, to identify the range of problems and concerns with No.2 fuel oil amongst the oil heat industry, to examine trends in fuel oil property variations by creating a fuel property database, guidelines for minimizing or resolving some of the most common fuel-related problems will also be developed to help the industry deal more effectively with fuel quality changes. The goal of this project is to provide a background of information for future actions by the industry to deal with problems that relate to the fuel, thus ensuring proper and efficient operation of the heating equipment in which it is to be used.

**33672** (BNL–52284, pp. 147-151) **Fuel quality - An industry perspective.** Greenes, R. (Petroconsultant, Inc., Scarsdale, NY (USA)). Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

This paper discusses what fuel quality means to users, producers, and suppliers and how recent EPA rules on diesel fuel (on-road use) pollution controlwill impact the off-road or stationary (home heating) use of number 2 fuel oil. The historical perspective in the development of standards of fuel quality and uses is addressed as are recent EPA rule making and sulfur content limits of several states.

**33673** (BNL–52284, pp. 190-192) **Workshop group A - Fuels, fuel quality and storage.** Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology*

*conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

The Chairman began the workshop session with the topic of fuel quality. This took up approximately 60% of the available discussion time. The remaining 40% of the time was devoted to the problems of fuel storage. The discussions on fuel quality emphasized three main questions: (1) what level of quality is needed by the oil heat industry; (2) who should be responsible for maintaining this level of quality; (3) what are the effects of the recent move by the Federal Government (Environmental Protection Agency) to segregate the No. 2 fuel oil/diesel pools? The remaining time allocated to the workshop was devoted to the problems associated with storage of the oil at the end-user level. Here the basic problems are twofold: sludge and tank leakage.

**33674** (NIPER–533) **The thermodynamic properties of benzothiazole and benzoxazole.** Steele, W.V.; Chirico, R.D.; Knipmeyer, S.E.; Nguyen, A. National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States). Aug 1991. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-83FE60149. Order Number DE91002250. Source: OSTI; NTIS; GPO Dep.

This research program, funded by the Department of Energy, Office of Fossil Energy, Advanced Extraction and Process Technology, provides accurate experimental thermochemical and thermophysical properties for "key" organic diheteroatom-containing compounds present in heavy petroleum feedstocks, and applies the experimental information to thermodynamic analyses of key hydrodesulfurization, hydrodenitrogenation, and hydrodeoxygenation reaction networks. Thermodynamic analyses, based on accurate information, provide insights for the design of cost-effective methods of heteroatom removal. The results reported here, and in a companion report to be completed, will point the way to the development of new methods of heteroatom removal from heavy petroleum. Measurements leading to the calculation of the ideal-gas thermodynamic properties are reported for benzothiazole and benzoxazole. Experimental methods included combustion calorimetry, adiabatic heat-capacity calorimetry, comparative ebulliometry, inclinded-piston gauge manometry, and differential-scanning calorimetry (d.s.c). Critical property estimates are made for both compounds. Entropies, enthalpies, and Gibbs energies of formation were derived for the ideal gas for both compounds for selected temperatures between 280 K and near 650 K. The Gibbs energies of formation will be used in a subsequent report in thermodynamic calculations to study the reaction pathways for the removal of the heteratoms by hydrogenolysis. The results obtained in this research are compared with values present in the literature. The failure of a previous adiabatic heat capacity study to see the phase transition in benzothiazole is noted. Literature vibrational frequency assignments were used to calculate ideal gas entropies in the temperature range reported here for both compounds. Resulting large deviations show the need for a revision of those assignments. 68 refs., 6 figs., 15 tabs.

## 0250 Combustion

*Refer also to citation(s) 33670, 34309, 34310, 34311, 34312, 34313, 34314, 34315*

**33675** (BNL–52284, pp. 107-122) **Research in oil burner design and emissions control.** Celebi, Y.; Butcher, T.A.; Wei, Gang. Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

One of the undesirable byproducts of the combustion of distillate oil in heating systems is soot, which fouls heat exchanger surfaces and leads to reduced efficiency, corrosion and service problems. In prior studies at BNL soot (and other pollutants) have been examined from an emissions perspective. This paper reports on studies done of soot deposition on heat exchanger surfaces. The work includes analysis of soot deposits removed from home boilers, measurement of soot deposition rate and composition using a controlled temperature fouling probe, and studies of acid production in flames under a variety of conditions. This paper also reports on limited combustion tests done with a new air atomizer concept. This atomizer is novel because it uses very low atomizing air pressures (10 to 20 inches of water) but very high atomizing air flow rates (50 to 100% of the total combustion air). Air atomization might be achieved using a very high static fan in place of an air compressor. A new burner was designed and built for this atomizer and tests were done over a firing rate range from 0.25 to 0.5 gal./hr. of oil. Results indicate low $NO_x$, CO, excess air, and smoke.

**33676** (BNL–52284, pp. 153-165) **Retrofit potential and fuel quality effects for residential oil heating systems to improve efficiency and reduce emissions.** Hayden, A.C.S. (CCRL/ERL/CANMET, Ottawa, Ontario (Canada)); Lee, S.W.; Braaten, R.W. Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

The major contributor to global warming (The Greenhouse Effect) is carbon dioxide. Great reductions in emissions of this gas can be effected through retrofits of existing oil-fired heating systems. If fuels are degraded because of increased viscosity and aromatics content, increased emissions of carbon monoxide and hydrocarbons may, unfortunately, be expected.

**33677** (BNL–52284, pp. 197-199) **Workshop group C - Oil appliance venting technology.** Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

Chimney problems - Masonry chimney problems are widespread, particularly with high efficiency space heating and water heating equipment installations venting into existing older chimneys. Resistance to sidewall venting - There is general acceptance of sidewall venting at the state level; Massachuetts, Maine, New York are examples. Major venting problems - Odors, staining, condensation, corrosion, high tempeatures at outlet, noise, and wind effects are major problems seen in the field.

# 03 NATURAL GAS

## 0302 Reserves, Geology, and Exploration

*Refer also to citation(s) 33650, 33651, 33702, 34254, 34256, 34257*

**33678** (DOE/METC–91/6117, pp. 3-4) **Western gas research.** Frohne, K.H. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The Western Gas subprogram is a multidisciplinary effort supporting the development of low-permeability, tight gas reservoirs in the US. The purpose is to determine the economic risks and technical feasibility of producing natural gas from tight formations. To realize this purpose, laboratory and field research is conducted, and industry is encouraged to develop the necessary understanding, technologies, and strategies. In order to accomplish this, two broad objectives have been defined for the Western Gas research program: (1) to reduce the uncertainty of reservoir production potential through an increased understanding of the resource, and (2) to improve extraction technology so that industry can assume development of the resource. In pursuit of these objectives, the Western Gas research program consists of three technical elements - geologic research, generic research, and production research - and a program management function. Each of the technical elements is described here.

**33679** (DOE/METC–91/6117, pp. 5-14) **Preliminary report on the characterization of Tertiary and Cretaceous low-permeability (tight) gas-bearing rocks in the Uinta Basin, Utah.** Fouch, T.D. (Geological Survey, Lakewood, CO (USA)); Pitman, J.K.; Schmoker, J.W.; Dolton, G.L.; Wandrey, C.J.; Nuccio, V.F.; Rice, D.D.; Wesley, J.B. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AI21-83MC20422. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

US Geological Survey studies of oil- and gas-bearing Upper Cretaceous and lower Tertiary strata in the basin are designed to characterize the reservoir units, and to assess the gas resources in the basin's tight siliciclastic reservoirs. The US Department of Energy's Western Tight Gas Sands Program is a major funder of this endeavor as are the US Geological Survey's Onshore Oil and Gas, and Evolution of Sedimentary Basins Programs. This preliminary report indicates the nature and progress of some studies being pursued in support of the characterization and assessment effort. The paper describes stratigraphy and structure of gas-bearing strata, thermal history, natural gases, reservoir characterization, and drill stem test analysis. Analysis of gas in tight-gas rock reservoirs of the southeast part of the Uinta Basin indicate that the gas has migrated from underlying Upper Cretaceous source rocks through fractures and faults to overlying Teritary and Upper Cretaceous strata. Petrographic and core analysis indicate values of porosity in rocks that have been heated to high temperatures will be quite low. Most fluid and gas migration is through fracture permeability paths. The volume of gas in reservoirs in the normally-pressured strata of the untested part of the basin may be optimized in those rocks along these migration pathways. Recoveries of gas will likely be limited in deeply buried rocks with few natural fractures because faults and fractures are probably necessary in many areas for both filling and draining the reservoirs.

**33680** (DOE/METC–91/6117, pp. 15-20) **Systems analysis of low permeability natural gas formations in the western United States.** Duda, J.R.; Klara, S.M. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Systems analysis at the Morgantown Energy Technology Center (METC) is focused to support the US Dept. of Energy's (DOE's) natural gas research program. Systems activities include developing and enhancing geologic models of basins containing low-permeability, gas-bearing formations, estimating in-place resources, and estimating recoverable gas volumes as a function of technology and wellhead sales price. The geologic characterizations include descriptions of structure, stratigraphy, and reservoir engineering properties. These data are collected from existing databases, published cross sections, etc., and provide the basis for estimating the in-place resource. The geologic descriptions are subsequently integrated with technology performance, cost, and financial analysis models. Collectively, the data, assessment models, and study results represent METC's systems analysis. Results are presented from the Washakie and the San Juan basins.

**33681** (DOE/METC–91/6117, pp. 21-29) **Geotechnology for low-permeability gas reservoirs.** Warpinski, N.R. (Sandia National Labs., Albuquerque, NM (USA)); Lorenz, J.C.; Sattler, A.R.; Phillips, L.R. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AC04-76DP00789. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

This project provides geotechnical support to the Department of Energy's Western Gas Sands Subprogram. The approach is to use existing geotechnical capabilities and the broad base of reuslts and expertise from the Multiwell Experiment and apply them in areas of sedimentology and natural fractures, geomechanics and in situ stress, and stimulation. The paper describes results of the following studies: extrapolation of the Multiwell Experiment, fractures, stress, analysis of Slant Hole Completion Test well, paludal zone, Cozzetti sandstone, cared hydraulic fractures, laboratory studies, and the SAGE (Sandia Advisor for Gas Extraction) expert system.

**33682** (DOE/METC–91/6117, pp. 30-45) **An evaluation of co-planar lineament analysis and some thoughts on using surface geological data to predict subsurface geology.** Smith, A.C. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

This study is an evaluation of the usefulness to natural gas exploration and development of a computerized method of mapping lineaments on the Earth's surface. The lineament mapping technique discussed in this paper is known as co-planar lineament analysis, and was developed by Eliason (1984). An attempt has been made to establish a correlation between lineaments at the Earth's surface, which may indicate fracturing of the surface rock, and fractures in natural gas producing rocks below the Earth's surface. The Douglas Creek Arch was chosen for this study because of its long history of gas production from nearly 500 fairly dense and uniformly spaced wells in the Mancos B Sandstone. The paper describes the geology of the Douglas Creek Arch, co-planar lineament analysis, and co-planer lineaments compared with other data. The conclusion of this study is not that co-planar lineament analysis will never work in the search for unconventional gas. Rather it is that its application to natural gas exploration and development will not work everywhere. Areas where the technique would be best employed would probably be those where the reservoir is relatively shallow, the surface rocks and reservoir rocks are similar in age and lithology, and where the subsurface geology is relatively simple with no unconformities, thrust faults, or plastic layers such as salt or soft shale between the surface and gas reservoir.

**33683** (DOE/METC–91/6117, pp. 46-55) **Extrapolation of MWX data into the Piceance Basin, Colorado.** Hill, R.E. (CER Corp., Las Vegas, NV (USA)); Kukal, G.C.; Branagan, P.; Wei, M. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AC21-88MC24120. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The principal objectives of this investigation are to advance the technology developed at MWX into other areas of the Piceance Basin and verify the extrapolation potential of the geological and engineering findings and techniques; reliably identify and characterize potential areas for Mesaverde gas resource development; and develop an optimal methodology for developing this resource. The ultimate goal of this investigation is to transfer this technology, in whole or in part, to the industry operators (i.e., gas producers) who can implement the technology on a wide scale and significantly increase gas reserves. The Multiwell Experiment, a field laboratory consisting of three closely-spaced wells, studied the reservoir and production characteristics of the low permeability Mesaverde sands near Rifle, Colorado. This paper discusses results of the following: log interpretations of gas and water distribution, field verification test from the Central Basin, fractures and stresses, pressure transient test, and field verification test from Southwest Flank.

**33684** (DOE/METC–91/6117, pp. 67-69) **Eastern tight gas project.** Yost, A. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Research in the eastern tight gas project is a multidisciplinary effort that is directed toward developing a reserve base to help

private industry provide a long-term supply of natural gas from Devonian shale, tight sands, coal seams, and other low-permeability formations located primarily in the Appalachian, Illinois, Michigan, Warrior, Richmond, Arkoma, and other basins located in the eastern, mid-continent, and greater southwestern areas of the US. More specifically, the subprogram objectives are as follows: (1) identify and evaluate the resource-reserve base for eastern tight resources and develop a well-siting methodology to reduce dry hole risk; (2) conduct jointly funded, government-industry projects to test the applicability of gas recovery concepts to commercial production; (3) conduct cost-effective, geotechnical reserach in instrumentation, modeling, and tool development to reduce the cost of new technology; and (4) coordinate projects with GRI (Gas Research Institute) to ensure that respective research programs are complementary. These programs are briefly discussed and accomplishments to date and summarized.

**33685** (DOE/METC–91/6117, pp. 78-81) **Multi-strata exploration and production study.** Overbey, W.K. Jr. (Beckley College, Inc., WV (USA)); Locke, C.D.; Reeves, T.K.; Salamy, S.P.; Brunk, R. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AC21-89MC26026. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The objectives of this project are to: demonstrate low-cost exploration techniques in a relatively lightly developed area of southern West Virginia; add significant by-passed methane reserves to the traditional natural gas base recognized in the conventional Mississippian and Pennsylvanian reservoirs; demonstrate state-of-the-art engineering designs for well completions that would allow production of both the natural gas and methane from a single wellbore simultaneously; and analyze, evaluate and demonstrate to industry the economics of such a program on a full scale basis in an area with both coal and conventional shallow natural gas reservoirs. The paper describes a geostatistical exploration method, gives results from reservoir engineering and engineering design studies, and discusses the current status of the project.

**33686** (DOE/METC–91/6117, pp. 87-107) **Results of horizontal well site evaluations in fractured Devonian shale reservoirs.** Mroz, T.H. (Morgantown Energy Technology Center, WV (USA)); Schuller, W.A. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Several geologic mapping techniques, including geophysical and geochemical surveys, are used to define the orientation and production potential of fractured fairways in the Devonian shales. A flow sheet was developed to evaluate each site to determine if reservoir criteria are met to drill a horizaontal well. The input data varies for each area and is dependent on data availability. Four directional well-site evalutaions are presented to show the rationale behind the selection of the sites and how well design geometry is determined. Detailed analysis of well log data and surface geology are used to develop a three-dimensional model of the reservoir target. Seismic data is intergrated, when available, to enhance detection of increased fracture porosity. The relationship of near-surface fracture trends to subsurface geologic structure is delineated using soil gas and water geochemistry and dual-depth resistivity surveys. The data are then integrated to form a reservoir model of the potential site and the basis for well design. The four sites include the initial research well in Wayne County, West Virginia; a high-angle well project in Roane County, West Virginia; a horizontal well project in Putnam County, West Virginia; and the most recent site in Martin County, Kentucky.

**33687** (DOE/METC–91/6117, pp. 149) **Deep gas.** Gwilliam, W.J. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Deep gas research emphasized studies of natural gas in subduction emplaced sediments and in deep sedimentary basins. Central to the subducted zone research is the hypothesis that natural gas is generated in sediments carried to great depths, providing a deep gas source and potentially providing source gas to shallower, drillable traps through deep fracture systems. The Cordilleran Geologic Province was selected as the prime area for study because of its modern (active) and fossil (inactive) subduction zones. The specific area of interest in this province encompasses approximately 1.5 million square miles of the western US (including Alaska) and Canada. Results to date include (1) geologic and geophysical evidence of deeply emplaced sedimentary rock units at depths exceeding 30,000 feet in western Washington and south-central Alaska, and high-resolution, seismic-reflection verification of structures defined by reconnaissance geophysice (gravity, majnetic, and magnettotelluric techniques) in western Washington; (2) a new methodology for verifying deep methane stability with fluid inclusion studies; and (3) a preliminary gas resource estimate of 3,000 trillion cubic feet. Deep gas reserach in deep sedimentary basins is focused initially on deep reservoir questions of porosity and permeability preservation, hydrocarbon generation and preservation, and migration pathways in high-ranked deep basins of the US.

**33688** (DOE/METC–91/6117, pp. 150-151) **Gas hydrates.** Malone, R.D. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Gas hydrate research is a part of the Unconventional Gas Recovery (UGR) Program, a multidisciplinary effort that focuses on developing the technology to produce natural gas from resources that have been classified as unconventional because of their unusual geologies and unique production mechanisms. The approach to developing the necessary knowledge and understanding of gas hydrates consists of ongoing efforts that emphasize geological studies; characterization of the resource; and supporting research which includes modeling of reservoir conditions, production concepts, and predictive strategies for stimulated wells. Complementing this work, reserach also focused on understanding the in-situ detection of hydrate deposits and, ultimately, field tests to verify extraction methods. In pursuit of these efforts, the gas hydrate research project is made up of three technical elements and a project management function. The project management function is a DOE function of planning, execution, control, and technical integration of the project. Each of the technical elements is described here: Geologic Research; Generic Research; and Production Research.

**33689** (DOE/METC–91/6117, pp. 152-161) **Infield reserve growth/secondary natural gas recovery: Targeted technology applications for infield reserve growth - Year two report.** Finley, R.J. (Univ. of Texan, Austin (USA)); Guevara, E.H.; Levey, R.A. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract FG21-88MC25031. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The objective of this project is to define the potential for incremental gas recovery based on better understanding of depositional and diagenetic heterogeneity within known nonassociated gas reservoirs. Where significant geologic variation occurs, untapped or bypassed reservoir compartments remain to be drained of natural gas by drilling or recompleting strategically placed development wells. Deeper pool potential, which is closely related to producing depositional systems, can be better defined by sequence stratigraphy and also offers opportunities for increased reserves. However, because deeper pool drilling is part of standardindustry practice more related to exploration than development, it is not a major focus of this project. Approaches to defining the distribution of unrecovered resources by depositional system and methods for

maximizing their recovery are beng developed and tested as part of the Infield Reserve Growth/Secondary Gas Recovery (SGR) Project. This project is focused specifically on Texas natural gas reservoirs as a major subset of the Nation's natural gas resource base. The paper describes the project, then gives results on the following: scales of heterogeneity - an example from McAllen Ranch field; petrophysical analysis; engineering assessment; geological heterogeneity; assessment of facies heterogeneity in fluvial reservoirs - Seeligson and Stratton fields; screening techniques for assessment of Stratton reservoir heterogeneity; engineering techniques - well testing Stratton, and methology for selecting carbonate study areas.

**33690** (DOE/METC–91/6117, pp. 185-191) **Geophysical reconnaissance for deep methane source rocks.** Stanley, W.D. (Geological Survey, Denver, CO (USA)). USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AI21-83MC20422. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The broad objectives of the activities under this task are to locate deep sedimentary complexes in the western Cordilleraq of the US using deep investigative geophysical methods. Both reconnaissance and detailed surveys using magnetotelluric (MT) soundings have been coupled with gravity and magnetic data to locate geophysical anomalies that may represent deeply emplaced sedimentary rocks in fosslil subduction zones or other structural settings. In FY90 the objectives were to provide further detailed geophysical investigations into the very promising southern Washington Cascasdes region where MT surveys outlined a possible sutured sedimentary complex beneath volcanic rocks. The proposed sedimentary complex is interpreted to correspond to an anomalous conductive region called the southern Washington Cascades conductor (SWCC). The main field activities during FY90 involved acquisition of a new aeromagnetic data set covering the main part of the Morton anticline region, with east-wets flight lines, 1,000 feet above the ground, and with $\frac{1}{2}$ mile spacing. This data will be compatible with other high-quality data available west, north and south of the study area and will allow compilation of a highly-improved regional aeromagnetic map covering the southern Washington Cascades and nearby Chehalis basin. In addition, airborne electromagnetic resistivity data were obtained simultaneously with the magnetic data to provide information on occurrences of conductive marine sediments in the near surface. Results are discussed.

**33691** (DOE/METC–91/6117, pp. 192-196) **Potential for natural gas resources in deep sedimentary basins.** Dyman, T.S. (Geological Survey, Denver, CO (USA)); Fox, J.E.; Higley, D.K.; Keighin, C.W.; Magoon, L.B. III; Pollastro, R.M.; Schenk, C.J.; Schmoker, J.W. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The US Geological Survey, in cooperation with State agencies and with the support of the US Department of Energy, will initiate a program of research to determine the geologic framework and processes controlling deep gas occurrence in onshore part of Gulf Coast province. Although deep gas potential exists offshore, the onshore data are publicly available and much information is available in pubic literature. The study area will be the Louisiana-Mississippi salt basins (including Alabama). At the request of DOE, the USGS will work with the State agencies in developing a computerized data base of subsurface information that can be used for reconstructing the petroleum geology and will serve as a basis for evaluating the potential. The project will result in the publication of geologic reports, such as regional cross sections and maps, analyses, and interpretations of thermal maturity, reservoir properties, natural gases, and source rocks and discussions of processes involving basin evolution, reservoir and trap development, thermal history, and hydrocarbon generation, and migration that have direct bearing on the distribution and resource potential and eventual exploitation of deep gas resources.

**33692** (DOE/METC–91/6117, pp. 205-214) **Terrestrial gas hydrate occurrences.** Bird, K.J. (Geological Survey, Menlo Park, CA (USA)); Collett, T.S.; Kvenvolden, K.A.; Lee, Myung W. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AI21-83MC20422. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The primary objective of the DOE-funded USGS Gas Hydrate Program is to assess the production characteristics and economic potential of gas hydrates in northern Alaska. The objectives of this project for FY-1991 will include the following: (1) map the gas-hydrate/free-gas occurrences in the Prudhoe Bay-Kuparuk River area with newly acquired industry seismic data; (2) characterize and quantify the well-log characteristics of gas hydrates; and (3) characterize the gas hydrate occurrences in the Walakpa Gas Field in northern Alaska. The project description and results to date are given.

**33693** (DOE/METC–91/6117, pp. 231-240) **Seismic interpretation of gas hydrates in the Blake Ridge area.** Dillon, W. (Geological Survey, Reston, VA (USA)). USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AI21-83MC20422. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The purposes of this project are: (1) to determine the amount of methane that is bound in gbas hydrates in marine sediments, (2) to understand the distribution of gas hydrates and (3) to relate the amounts and distribution of hydrate to geological settings and geological/geochemical processes. Previously, seismic profiling data has been used as evidence for gas hydrates in marine sediments. Such data can be used to identify hydrates because a seismic reflection is produced by the base of the layer of gas hydrate that forms just below the sea floor. Results are discussed on the following: computer processing of seismic reflection data; seismic modeling for interpretation of gas-hydrate effects; interpreting profiles; and mapping.

**33694** (DOE/METC–91/6117, pp. 307) **Deep source gas seismic survey - Washington state.** Guide, M.; Krehbiel, S.C. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Deep Source Gas Research is intended to investigate the hydrocarbon potential of deep sedimentary basins in unexplored and unconventional areas. In particular, the relationship between plate tectonics, sedimentary deposition, and hydrocarbon generation is a subject of special interest. A regional geophysical study of southwest Washington, using a method known as magnetotellurics, found anomalous rock characteristics in an area roughly bounded by Mt. Rainier, Mt St. Helens, and Mt. Adams. This anomaly could be caused by the presence of a large volume of organically enriched sediments which, if present, could act as source rocks for natural gas generation. A seismic reflection survey was sponsored by METC to further investigate this possibility. Four METC seismic lines totalling 147 km and one 53 km commercial seismic line were obtained from 1988 to 1989. Preliminary interpretation appears to support the possibility of a large volume of deeply buried sediment as indicated by the magnetotelluric data. The seismic reflection data depicts a complex geologic history of the area involving deposition of early to mid-Eocene sediment followed by emplacement of intrusives and the development of the current volcanic environment. The stratified nature of the relectors within the magnetotelluric anomaly area could indicate low energy sedimentary deposition. Sediment of this type could be favorable to natural gas generation. Future work will include the intergration of new seismic

reflection data acquired this summer along with a METC-sponsored study of the local surface geology. The final interpretation will be used to propose a drill site for stratigraphic and hydrocarbon potential evaluation.

**33695** (DOE/METC–91/6117, pp. 325) **Gas hydrates of the Arctic.** Bird, K.J. (Geological Survey, Menlo Park, CA (USA)); Collett, T.S.; Kvenvolden, K.A.; Lee, Myung W. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AI21-83MC20422. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Sediments of the Arctic region may contain enormous quantities of natural gas in the form of gas hydrates, which are crystalline substances composed of water and mostly methane. These ice-like substances are generally found in two distinct environments: (1) offshore, in sediment of outer continental margins; and (2) in nearshore to onshore areas associated with the occurence of permafrost. The presence of gas hydrates in offshore continental margins have been inferred mainly from the occurrence of anomalous bottom-simulating reflectors (BSRs) on marine seismic records. Within the sediments of the Arctic Ocean region, BSRs have been mapped at subbottom depths ranging from about 100 to about 1,100 meters. Onshore in the Arctic gas hydrates are present in western Siberian platform the Timan-Pechora province, the eastern Siberian craton, and in the northeastern Siberian and Kamachatka areas of the Soviet Union. In the North American Arctic, well-log responses attributed to the presence of gas hydrates have been obtained in about a fifth of the wells drilled in the Mackenzie Delta, and in the Arctic Islands over half of the wells are inferred to contain gas hydrates. In northern Alaska gas hydrates have been identifies in 34 industry wells using well-log responses calibrated to an interval in a well where gas hydrates were recovereed in a core. The combined information from Arctic gas-hydrate studies shows that in permafrost regions, gas hydrates exist at sub-surface depths ranging from about 130 to about 2,000 meters.

**33696** (DOE/METC–91/6117, pp. 326) **Clathrates in the Arctic regions.** Max, M.D. (Naval Research Lab., Washington, DC (USA)). USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Clathrates (gas hydrates) are medium to high pressure-stabilized, ice-like compounds stabilized by higher than sea level ambient pressure found in the cold, deep-ocean environment, especially the polar oceans. Clathrate form in the Clathrate Stability Zone (CSZ), a thermodynamically stable zone that extends downward from the sediment surface to a depth determined by the local heat flow and sedimentation rate conditions. The CSZ is thicker in deeper water where pressure is higher. The lower part of the CSZ can become solid and can act as a gas trap, and the base of the CSZ is the pressure-temperature phase boundary of the gas+water/clathrate reaction. From 180 to 200 volumes of gas can be concentrated in one volume of clathrate. Natural gas clathrates probably occur over broad areas of the Arctic Ocean and northern Nordic Sea. By analogy with identifications elsewhere, shallow gas reservoirs can be expected within 1.5 km of the sediment surface of the north polar ocean basins. Clathrates and trapped gas in thickly sedimented areas in the Arctic and Nordic seas have been identified locally in the west Barents Sea and northern Alaskas continental margins. Analysis of sediment thickness, sediment types, sedimentation history, and heat flow suggests that widespread generation of gas has been trapped in, and possibly below impermeable clathrate, over $1.5 \times 10^6$ km$^2$ of the Arctic and Atlantic polar region. Clathrates can be expected to occur in sediments of most of the Canada and Wrangel Basins, and along most of the continental slope and rise sediments. If clathrates prove to be developed over the predicted regions, thay could hold over $8 \times 10^6$ km$^3$ of natural gas. Clathrates and related gas deposits may thus comprise major energy resources.

**33697** (DOE/METC–91/6117, pp. 327) **Application of remote geologic analysis to gas exploration in Devonian shale.** Foley, M.G. (Pacific Northwest Lab., Richland, WA (USA)); Mroz, T.H.; Pratt, H.R. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AC06-76RL01830. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Pacific Northwest Laboratory's (PNL) Remote Geologic Analysis (RGA) system uses a unique, automated, pattern-recognition approach to identify potential fracture zones (of any dip from vertical to less than 40°) by coplanar analysis of their geomorphic expressions in digital models of topography. For its first oil- and gas-related field trial, the RGA system was applied to the fracture characterization of the Morgantown Energy Techynology Center's Study Area 1 in the Big Sandy Gas Field in southwest West Virginia. This site was selected for a blind test of the technology because of the characterization data available from well drilling, gas production, and seismic surveys for evaluting the RGA results. The Morgantown staff used these data and performed a geologic analysis of the region coincidentally, but separately, from the PNL fracture analysis to ensure that a bias would not be introduced into the interpretations. Sturcture and isopach maps show significant trends in the faulting and folding of the producing formations that control production volumes, which correltate well with the principal interpreted fracture sets from the RGA results. Three fracture sets for the Big Creek, West Virginia, 1:24,000 quadrangle parallel major geologic structures that are associated with basement faulting (steep dip, NE trend) and thrust faulting (60° dip, NW trend). These structures appear, in combination with anticlinal folding, to enhance gas production. To date, only the most prominent fractue planes form the RGA analysis have been correlated with the large-scale structural features (basement faulting) in the study area. The next step in this field trial will be to determine if lesser planar features from the analyses correlate with the detailed structural geology and regional geomorphology of the rocks exposed at the surface.

**33698** (DTH-LET-RE–90-6) **The effect of the number of pseudocomponents used in simulating gas condensate recycling in heterogeneous reservoirs.** Kossack, C.A. (Division of Petroleum Engineering, Norwegian Institute of Technology (NO)); Moraeus Hanssen, M.; Olsen, H.; Reffstrup, J. Trondheim Univ. (Norway). Norges Tekniske Hoegskole; Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik; Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark). Aug 1990. 67p. Order Number DE92703858. Source: OSTI; NTIS (US Sales Only).

The aim was to test the ability of lumped gas condensate systems to describe the complicated thermodynamic processes in compositional reservoir simulation with injection of off-gas into heterogeneous reservoirs. It was concluded that, as little as five components can be used to describe the behaviour of the gas condensate. A satisfactory match with the five component system was obtained by experimenting with the lumping and regression technique for the five component hydrocarbon mixture. Furthermore the first reservoir simulation results were used to identify important matching parameters in the recovery process. The homogeneous layered reservoir behaves very differently from the homogeneous reservoir. At typical field injection and production rates, gravity has only a small influence. The difference in the results between the small and large heterogeneities is rather small. The introduction of any type of heterogeneity into the condensate displacement process reduces the recovery of liquids when compared to the homogeneous results. The introduction of small size heterogeneties increases the dispersion between the injection gas and the condensate and the recovery decreases, on average, 3% of IOIP. The presence of large heterogeneities causes bypassing of the lower permeability layers and reduction of the recovery of liquids of (on average) just over 3% of IOIP. The presents of homogeneous layers causes substantial bypassing and the loss of more than 6% of the IOIP. (AB) 13 refs.

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**33699** (DOE/METC–91/6117, pp. 56-63) **Slant hole completion test Mesaverde Group, Piceance Basin, Colorado.** Myal, F.R. (CER Corp., Las Vegas, NV (USA)); Kukal, G.C.; Hill, R.E. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AC21-90MC26024. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The objective of the slant hole completion test is to evaluate directional drilling as an alternative development strategy for the tight, naturally fractured sands and coals in the Mesaverde Group in the Piceance Basin. This paper discusses the drilling, coring, logging and casing operations for the slant hole. The surface location for the slant hole completion test is 700 feet south of the DOE Multiwell Experiment site in Section 34, T6S, R94W, Garfield County, Colorado. The hole was designed to intersect the paludal Mesaverde 3 and 4 sands and bounding coals at 60° beneath the Multiwell pad, and to proceed north to intersect the Cozzette at 88° and drill parallel to bedding for a distance of 500 feet. The well was positioned to drill normal to the regional fracture trend as identified in previous studies undertaken at the Multiwell Experiment. The slant hole completion test was spudded April 10, 1990 and reached 9,466 feet TMD in the Cozzette August 4, 1990. Drilling results are discussed.

**33700** (DOE/METC–91/6117, pp. 70-77) **Hydraulic fracturing of the Devonian shale with a non-damaging fluid.** Mazza, R.L. (Petroleum Consulting Services, Canton, OH (USA)); Gehr, J.B. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AC21-90MC26025. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The Phase I base program investigates the effectiveness of hydraulically stimulating an Appalachian Basin, tight, fractured, Devonian Shale interval with a non damaging fluid - carbon dioxide and sand by comparison of the resulting gas production with that from nearby conventionally stimulated wells. It includes up to fifteen wells in up to five target areas located in Kentucky, Ohio, Tennessee, Virginia, and West Virginia. The liquid $CO_2$ and sand stimulation treatment requires a specially designed blender which contains the sand in a closed vessel where it is slurried with liquid $CO_2$ at a pressure of 250 to 300 psi. The blender has a capacity of up to 70,000 pounds of sand, although this proposal is utilizing a blender with a reduced sand capacity of 48,810 pounds. Canadian Fracmaster, a Canadian based oil field service company has designed and patented a blender to perform these services. Project activities to date are described.

**33701** (DOE/METC–91/6117, pp. 82-86) **Measurement-while-drilling (MWD) development for air drilling.** Harrison, W.H. (Geoscience Electronics Corp., Westlake Village, CA (USA)); Rubin, L.A. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AC21-88MC25105. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The objective of this program is to tool-harden and make commercially available an existing wireless MWD tool to reliably operate in an air, air-mist, or air-foam environment during Appalachian Basin oil and gas directional drilling operations in conjuction with downhole motors and/or (other) bottom-hole assemblies. The application of this technology is required for drilling high angle (holes) and horizontal well drilling in low-pressure, water sensitive, tight gas formations that require air, air-mist, and foam drilling fluids. The basic approach to accomplishing this objective is to modify GEC's existing Cableless MWD tool to improve its reliability in air drilling by increasing its tolerance to higher vibration and shock levels (hardening). Another important aim of the program is to provide for continuing availability of the resultant tool for use on DOE-sponsored air-drilling programs. Specifications which were required are listed. Phase 1 has been completed, and this report describes phase II and III field tests.

**33702** (DOE/METC–91/6117, pp. 108-117) **Horizontal wells in the Devonian shale.** Overbey, W.K. Jr. (BDM Engineering Services Co., McLean, VA (USA)); Locke, C.D.; Reeves, T.K. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AC21-89MC25115. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The objective of this project is to obtain data that will determine the economics of drilling a horizontal well, completing it with multiple hydraulic fracture stimulations, and comparing the resulting gas productivity with that from conventional vertically drilled and stimulated wells in the test area. A further objective was to transfer the technology to industry through cost-sharing cooperative projects. The paper describes the geologic evaluation, site selection, work plan, drilling operations, logging and completion operations, stimulation operations, and well test, analysis, and production monitoring. The first well has been drilled, stimulated and is currently producing gas. The second well will be drilled during Noverber 1990 in Calhoun County, West Virginia.

**33703** (DOE/METC–91/6117, pp. 118-127) **Drilling and completion of a horizontal Devonian shale well: Martin County, Kentucky.** Koziar, G. (Columbia Gas System Service Corp., Columbus, OH (USA)); Ahmad, M.M.; Friend, L.L. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract AC21-89MC26343. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

This project consists of nine base and five optional tasks. The base activities were devised to select the most favorable site for the horizontal well and to design and implement drilling, logging, completion and stimulation efforts. Well testing is the only optional task that was executed. The Program Schedule identifies the individual project tasks. Geologic Area for the Horizontal Well and Reservoir and Geologic Evaluation tasks were undertaken to identify, evaluate and rank candidate locations, and to select a site suitable for the horizontal well. Well 21747, located in the Pigeonroost Prospect in southeast Martin County, Kentucky, was selected as the site for the horizontal well installation. Once the desired location was identified, site preparation activities commenced. Upon completion of the Well Stimulation and Well Testing tasks, and connection of the well to the gathering line, production will be monitored for five years. A technical assessment of the impact of horizontal well drilling and stimulation on productivity will be made by comparing resulting production between well 21747 and offset vertical wells. Economics will ultimately determine the viability of horizontal well application to the Devonian shale.

**33704** (DOE/METC–91/6117, pp. 128-135) **PrimeEnergy/DOE/GRI slant well: A directional drilling case history.** Drimal, C.E. (PrimeEnergy Corp., Stamford, CT (USA)); Muncey, G. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

This paper presents preliminary results of a high-angle Devonian Shale development well in the Alleghany Plateau of west central West Virginia. The well was drilled on the foreland flank of the Chestnut Ridge anticline; a structure closely associated with a fairway of locally significant Devonian Shale gas production. The target of the well was a tabular, southeast-dipping, fractured zone near the top of the Lower Huron member of the Devonian-age

Ohio Shale. The well was conventionally drilled to a kick off point of 2,150 feet. Positive displacement motors were then used to build inclination, at an average of 9° per 100 feet, to an inclination of 67° at a true vertical depth of 2,954 feet. Conventional rotary assemblies were then used to drill the slant section of the well, across a 1,500 foot target section, to a true vertical depth of 3,571 feet. Hydraulic fracturing treatments were performed in four separate stages. Each interval was treated with straight nitrogen in volumes ranging from 1,170,000 to 1,800,000 standard cubic feet after breakdown with 400 to 500 gallons of 7.5% acid. Aggregate open flow from all zones tested at 1,400,000 standard cubic feet per day; approximately a three-fold improvement over the average vertical well in the area. An economic model is presented which suggests that risks associated with fracture distribution and gas recoverable from individual fractured zones can render a directional drilling program uneconomical, pointing to the importance of well-site selection and well design. Economic success or failure of this project is, as yet, uncertain. The economic success of directional drilling as a strategy in the Devonian Shale, however, will be revealed only as many more such wells are drilled.

**33705** (DOE/METC–91/6117, pp. 136-146) **Eastern gas systems analysis: Devonian Shales - Tight sands.** Zammerilli, A.M.; Layne, A.W. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Eastern Gas Systems Analysis studies are being performed to determine the conditions under which gas produced through application of advanced technologies is economically attractive for selected residential, utility, commercial, and industrial markets. For advanced technologies such as horizontal drilling in the Devonian shales, these conditions are determined through the use of geologic screening and computer simulations of gas production, reservoir stimulation design, and economic-risk analysis. A major strength of the computer simulations is the use of probability distribution to address uncertainty. METC is also developing a market analysis methodology for advanced technologies. These areas are being examined to support the horizontal well technology and unconventional gas resource projects under the DOE Fossil Energy Program. Descriptions of the projects and results to date are given for the following: tight gas analysis of the eastern tight gas sands; stimulation modeling for horizontal wells, including fractured Devonian shale risk analysis and risk assessment for Devonian shale stimulation; and probabilistic analysis of horizontal well costs.

**33706** (DOE/METC–91/6117, pp. 215-230) **Study of hydrate dissociation by methanol and glycol injection.** Sharma, G.D. (Univ. of Alaska, Fairbanks (USA)); Kamath, V.A. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. DOE Contract FG21-86FE61114. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The research undertaken in this project addresses the evaluation of various methods such as depressurization, hot water, brine, methanol, glycol and steam injection for production of natural gas from Arctic natural gas hydrate resources. The major project objectives include: measurement of permeability changes during formation of dissociation of hydrates in porous media; gathering of experimental data on hydrate dissociation for various processes and understanding dissociation kinetics; development of numerical models (finite difference and finite element) to model hydrate dissociation in porous media; and study of hydrate dissociation under drilling conditions to provide guidelines for safer drilling.

**33707** (DOE/METC–91/6117, pp. 243-244) **Natural gas to liquids.** Malone, R.D. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The natural gas to liquids (NGTL) conversion research is a multidisciplinary effort focused on the development of an economic, one-step process that will convert natural gas to gasoline or distillates. This research effort is expected to produce process technology to convert natural gas to higher value uses and to provide a means of transporting natural gas from remote locations to the marketplace. One of the most promising options is to convert the gas to liquid fuels such as methanol or gasoline. Conventional technology using steam reforming is economically unfeasible. Other techniques, such as direct catalytic oxidative coupling, have potential for significant cost reduction. Therefore, this research effort has been initiated to develop new or improved techniques specifically related to rate and efficiency of conversion. In pursuit of these goals, the approach to NGTL conversion research is as follows: (1) Development of a major cost reduction through the exploration of new concepts to simpligy the process, improve yields and selectivity, and improve separation and recovery of the product. The long-term research approach is to seek the ultimate, one-step conversion process with high yield, high selectivity, and high separation/recovery efficiency. The achievement of these goals will result in a competitive process on both large and small scales. (2) Achievement of the major cost reduction through the development of catalytic, non-catalytic, and biologic processes, as well as trade-off evaluations of separation and recycle facilities for conversion and selectivity.

**33708** (DOE/METC–91/6117, pp. 245-249) **PETC's natural gas conversion program.** USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The technical goal of the program is to seek significant innovative improvements over state-of-the-art technologies for the conversion of natural gas at domestic and remote sites to marketable fuels and chemicals. The program is accopmlished through stages development from laboratory scale to bench scale finally to proof-of-concept scale. Currently, the three most advanced direct conversion technologies being studied are the following: Oxyhydrochlorination; Partial Oxidation; and Oxidative Coupling. The conversion of methane using enzymes is also being investigated but is still in its infancy. All four technologies are briefly described.

**33709** (DOE/METC–91/6117, pp. 250-259) **Gas phase and catalytic partial oxidation reactions of methane and oxygen.** Droege, M.W. (Lawrence Livermore National Lab., CA (USA)); Hair, L.M. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The effective utilization of remote natural gas requires research aimed at developing catalyzed reactions using oxygen that lead to partial oxidation or oxidative coupling of methane. Despite intensive efforts by many researchers, the best yields to C2 hydrocarbons have been in the 20 to 30% range, generally accomplished with catalysts which include an alkali metal on an alkali earth oxide, e.g., Li/MgO. These efforts have been focused on the development of a general chemical kinetic model to predict C2 yield and describe product trends as a function of generalized catalyst behavior. Reactions of interest include partial oxidation (forming methanol and formaldehyde) or oxidative coupling (forming ethane and ethylene) of methane using oxygen. In this report the authors describe their recent work in developing a chemical kinetic model designed to predict C2 yield and describe product trends as a function of generalized catalyst behavior. Methane activation and catalytic product hydrocarbon decomposition are described.

**33710** (DOE/METC–91/6117, pp. 260-269) **Methane oxidation over dual redox catalysts.** Klier, K. (Lehigh Univ., Bethelehem, PA (USA)); Herman, R.G. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors

review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The objectives of this research are to achieve and understand the partial oxidation of methane to oxygenates, especially methanol, and $C_2$ hydrocarbons over dual redox catalysts. The catalysts are based on oxidic materials that will exhibit structural and thermal stability for long reactor lifetimes. A continuous flow reactor system with oxygen or air as the oxidizing gas, rather than nitrous oxide, is being utilized over a wide range of pressures (1-100 atmospheres) and temperatures ($\leq$1,000C) in order to maximize the space time yields of the desired products. All of the investigated processes are catalytic and are aimed at minimizing gas phase reactions. The proposed research is divided into three tasks. Task 1 deals with preparation and testing of catalyst systems such as $Cu^{I}/Fe^{III}$ and $Cu_2^{I}/Sn^{IV}$ doped into ZnO. Task 2 aims at the extension of the Anderson-Tsai methanol chemistry in CuFe ZSM-5 with oxygen used as oxidizing gas, and at potential modifications of the double redox systems to produce $C_2$ hydrocarbons including extending the framework composition and pore size to that accessible in other silicates such as the stannosilicates. Task 3 involves optimization studies and high pressure studies of methane conversion over the most promising selective oxidation catalysts investigated in the previous tasts. Results to date are given and discussed.

**33711** (DOE/METC–91/6117, pp. 276-286) **Suprabiotic catalyst systems for selective oxidation of light alkane gases to fuel oxygenates.** Lyons, J.E. (Sun Refining and Marketing Co., Marcus Hook, PA (USA)). USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The objective of the work presented in this paper is to develop new, efficient catalysts for the selective transformation of the light alkanes in natural gas to alcohols for use as liquid transportation fuels, fuel precursors and chemical products. There currently exists no direct one-step catalytic air-oxidation process to convert these substrates to alcohols. Such a one-step route would represent superior useful technology for the utilization of natural gas and similar refinery-derived light hydrocarbon streams. This project is an experimental approach to the design, synthesis, characterization and testing of oxidation-active transition metal centers for cleaving the dioxygen molecule and producing metal oxo intermediates which react with alkanes to convert them to alcohols. The molecular environment in which the oxidation-active metal center is located is critical in generating active catalysts. It must tune the center electronically to access appropriate oxidation states and should enable two metal centers to participate in the oxygen splitting process. The authors are investigating three molecular environments which could be hospitable ones for the active species that they are trying to generate: (a) perhaloporphyrin, perhalophthalocyanine or related macrocycles, (b) polyoxometallates and (c) regular oxidic lattices such as zeolites and related structures. They are testing these three sets of catalysts for acitivity in the mild oxidation of light alkanes (isobutane, propane, ethane and methane).

**33712** (DOE/METC–91/6117, pp. 287-295) **Catalytic assessment of methane conversion to liquid fuels.** Driscoll, D.J.; Shamsi, A.; Siriwardane, R.V. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The overall objective of this research project is to identify and develop economically efficient processes for the conversion of natural gas to liquid fuels. Methane is the major component of natural gas; therefore, the specific objectives are (1) to prepare and test new methane conversion catalysts, (2) to conduct fundamental catalyst characterization studies in an effort to elucidate the overall reaction machanism for methane conversion and (3) to explore and develop novel concepts for the conversion of natural gas. A number of new materials have been identified which are capable of promoting the catalytic conversion of methane to $C_2$ products. These include a variety of perovskite compounds and several pure and doped metal oxide materials. A complete list of all the materials examined is given. The paper discusses results from the catalyst characterizations and low temperature catalyst development studies.

**33713** (DOE/METC–91/6117, pp. 301-303) **Systems analysis of natural gas resources from low-permeability formations.** Duda, J.R. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The purpose of the DOE Gas Research Implementation Plan is to provide a basis for greater utilization of the nation's natural gas resource by (1) enlarging and stabilizing the domestic gas supply reserve base (leading to increased public confidence in the long-term availability of affordable gas), and (2) increasing production from low-permeability formations. In general, the issue of natural gas from low-permeability formations is not whether natural gas is present or where the gas exists, but rather, economical production of the resource. Activities in the Western Gas Systems Analysis project include four specific tasks: targer high-potential resources; estimate reserves as a function of technology and price: assess improved and alternative extraction technologies: and define and prioritize extraction research. To accomplish these tasks, the methodology includes four types of modeling: Geologic Modeling, yielding new and enhanced geologic characterizations; Technology Performance Modeling, or providing estimates of the recoverable gas as a function of extraction technology; Cost Engineering Modeling, analyzing investments as a function of region and geology; and Financial Modeling, coupling technology with economics leading to estimates of natural gas reserves.

**33714** (DOE/METC–91/6117, pp. 304) **Geotechnical evaluations for siting horizontal wells in Devonian shale reservoirs.** Mroz, T.H. (Morgantown Energy Technology Center, WV (USA)); Schuller, W.A. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Several geologic mapping techniques, including geophysical and geochemical surveys, are used to define the orientation and production potential of fractured fairways in the Devonian shales. A flow sheet was developed for the evaluation of each site to determine if reservoir criteria are met to drill the well. The input data vary for each area and is dependent on data availability. Two, directional, well-site evaluations are presented to show well-siting rationale and, ultimately, well-design geometry. Detailed analyses of well-log data and surface geology were used to develop a three-dimensional model of the reservoir target. Seismic data were integrated, where available, to enhance detection of increased fractured porosity. The relationship of new-surface fracture trends to subsurface geologic structure was delineated using soil gas and water geochemistry and dual depth resistivity surveys. The data were integrated to form a reservoir model of the potential site and a form basus for well design. The two sites include a high-angle well project in Roane County, West Virginia, and a horizontal well project in Putnam County, West Virginia. The Roane County site utilized well data, geology, and soil gas chemistry to define fracture fairways, site the well, and formulate the well design. The Putnam County site was evaluated using similar data, plus water geochemistry, remote sensing, and shallow resistivity surveys. The methodology has proven successful in delineating enhanced fracturing related to gas production from the Middle Devonian shale sequence in the Appalachian Basin.

**33715** (DOE/METC–91/6117, pp. 308-315) **Parametric studies on catalytic and non-catalytic partial oxidation of methane, ethane, and ethylene.** Shamsi, A. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors

review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

It has been shown that by proper cation substitution in perovskite-type oxides, active and selective catalysts for the oxidative coupling of methane to higher hydrocarbons can be obtained. Recent studies showed that phase-phase reactions, especially at higher pressures, play a significant role in the partial oxidation of methane. Therefore, in order to gain further insight into these catalytic and non-catalytic systems, the effects of temperature and pressure on catalytic and non-catalytic conversion of methane to $C_2$+ hydrocarbons were investigated at several reaction conditions, both in the presence and in the absence of perovskite-type oxide, $La_{0.9}Na_{0.1}MnO_3$. This study has shown that the activation of methane, ethane, and ethylene accurred both in the gas phase and on the surfaces of a catalyst. Gas-phase reactions can be minimized by reducing the dead volume of the reactor. It appeared that carbon monoxide formed in the gas phase and was converted to $CO_2$ in the presence of the catalyst. This implies that surface reactions are important in oxidizing the intermediates $CH_3$, $C_2H_4$, $C_2H_6$, and CO to carbon dioxide. It was found that contact time, temperature, pressure, and the methane-to-oxygen ratio have a similar effect on the oxidative coupling of methane to $C_2$+ products, and are the major factors affecting the conversion and selectivity in the presence and absence of a catalyst.

**33716** (DOE/METC–91/6117, pp. 324) **The synthesis, characterization and catalytic reactions of metal silicate catalysts for the partial oxidation of methane.** Droege, M.W. (Lawrence Livermore National Lab., CA (USA)); Hair, L.M. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The authors are investigating the partial oxidation and oxidative coupling of methane as catalyzed by metal silicate aerogels. Reactor studies performed at 750C, 2:1 $CH_4$:$O_2$, 75% Ar dilution, 50 ccm and 2 psi show that Ti, V, Zr, Nb, Ta, and W silicate aerogels are primarily oxidation catalysts, with Ta, W, Zr and Nb producing mostly carbon monoxide. Investigations at different conditions for the Zr silicate aerogel show that, contrary to thermal reactions and most catalysts, when methane conversion increases so does selectivity to $C_2$ hydrocarbons. This characteristic combined with its high split towards carbon monoxide prompted further investigation of the Zr silicate aerogel. First, they looked at the effect of the atomic placement of Zr in the matrix. Comparison with a physical mixture of zirconium oxide with silica aerogel shows that the Zr silicate aerogel is significantly more active, and the physical mixture primarily produces carbon dioxide. Next, the effect of the greater surface area of the aerogel was studied. A pure zirconia aerogel was made with a surface area of 170 $m^2/g$ and compared to the pure zirconium oxide. The aerogel is more active, making mainly carbon dioxide. Sintering studies found that the mesopore structure is essentially removed by treatment at 1,100C, and that the activity of the Zr silicate aerogel is reduced to that of thermal reactions alone. Similar results were obtained for the silica aerogel. Current efforts are focused on the behavior of Zr silicate aerogel as a function of metal loading, reactant stoichiometry, flow rate, temperature and dilution. In addition, M-Zr silicate systems, where M includes Al, B, B-Ti, and W, are being investigated.

### 0306 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 33663, 33665, 33666, 33667, 33705, 34255, 34260, 34371*

### 0308 Environmental Aspects

**33717** (GRI–91/0045) **Ecological effects of pipeline construction through deciduous forested wetlands, Midland County, Michigan: Interim report, August 1988–August 1990.** Zellmer, S.D. (Argonne National Lab., IL (United States)); Rastorfer, J.R.; Van Dyke, G.D. Gas Research Inst., Chicago, IL (United States). Environment and Safety Research Dept.; Argonne National Lab., IL (United States). Jul 1991. 104p. Sponsored by Gas Research Inst., Chicago, IL (United States). DOE Contract W-31109-ENG-38. Order Number DE92000481. Source: OSTI; NTIS; INIS; GPO Dep.

Implementation of recent federal and state regulations promulgated to protect wetlands makes information on effects of gas pipeline rights-of-way (ROWs) in wetlands essential to the gas pipeline industry. This study is designed to record vegetational changes induced by the construction of a large-diameter gas pipeline through deciduous forested wetlands. Two second-growth forested wetland sites mapped as Lenawee soils, one mature and one subjected to recent selective logging, were selected in Midland County, Michigan. Changes in the adjacent forest and successional development on the ROW are being documented. Cover-class estimates are being made for understory and ROW plant species using 1 x1-m quadrats. Counts are also being made for all woody species with stems < 2 cm in diameter at breast height (dbh) in the same plots used for cover-class estimates. Individual stem diameters and species counts are being recorded for all woody understory and overstory plants with stems ≥2 cm dbh in 10 x 10-m plots. Although analyses of the data have not been completed, preliminary analyses indicate that some destruction of vegetation at the ROW forest edge may have been avoidable during pipeline construction. Rapid regrowth of many native wetland plant species on the ROW occurred because remnants of native vegetation and soil-bearing propagules of existing species survived on the ROW after pipeline construction and seeding operations. 91 refs., 11 figs., 3 tabs.

### 0340 Combustion

*Refer also to citation(s) 34313*

## 04 OIL SHALES AND TAR SANDS

### 0403 Drilling, Fracturing, and Mining

*Refer also to citation(s) 33659, 33684, 33686, 33700, 33702, 33714*

### 0404 Oil Production, Recovery, and Refining

*Refer also to citation(s) 33720*

**33718** (UCID–16986-91-1/2) **Oil Shale quarterly report, January–June 1991.** Cena, R.J. Lawrence Livermore National Lab., CA (United States). 6 Aug 1991. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018658. Source: OSTI; NTIS; GPO Dep.

The status of the LLNL Hot-Recycled-Solid (HRS) pilot plant is discussed. Ten engineering H-series runs were completed, with over 4 tons of shale processed. The authors have tested computer data acquisition systems and developed process control algorithms. They collected product shale oil in staged cooling vessels which is now being analyzed. The current oil collection system has allowed the authors to collect the oil and chill the gas to −20° prior to discharge. Wallman (1990) has made considerable progress in studying oil shale coking reactions. The authors are currently working to extend Wallman's original model to include a more complete description of the reacting system with two goals: (1) development of a sophisticated model of oil coking to be used to assist in interpreting results of laboratory experiments; and (2) development of a model suitable for use in their oil shale process model. The model developed for the steady state analysis of HRS oil shale retort has, up to this time, used a simplified, single phase, well-mixed model for the fluidized beds in the process. A slightly more complicated yet more accurate multiple phase model of a fluidized bed has now been developed which is implemented as a new process module in the code. The model has also been tested to determine both its accuracy, as compared to the single phase model, and it applicability to the analysis of the fluidized beds in the retort. Results of

simulations of both the fluid bed mixer and the fluid bed combustor using both the well-mixed and the new phase fluidized bed model are described. Models of abrasion are presented for oil shale being processed in either a lift pipe or a fluidized bed. Both of these unit operations are used in the Lawrence Livermore National Laboratory HRS process.

### 0405 Properties and Composition

*Refer also to citation(s) 33718*

### 0407 Health and Safety

*Refer also to citation(s) 33667*

### 0409 Waste Management

*Refer also to citation(s) 33718*

**33719** (VYH-JULK–A64) **Geotechnical properties and environmental effects of tailings.** Saarela, J. National Board of Waters and the Environment, Helsinki (Finland). 1990. 148p. (In Finnish). Order Number DE92703991. Source: OSTI; NTIS (US Sales Only).

The purpose of this research was to study geotechnical properties and environmental effects of tailings. The results of this investigation are needed e.g. to estimate the future needs of further observations of the full tailing areas of closed mines. Field researches were made at Kotalahti, Vihanti and Lahnaslampi mines in 1987-1988. According to the results further observation of full tailing areas investigated is not needed because they dry quickly and the stability of the dams is adequate. The stability calculations were made for the long term stability, in which the change of the pore pressure (delta u) has reached the final position. The stability of the dams are F min. = 2.31 - 2.63. Environmental consequences of tailings were studied by taking water and soil samples in the near surroundings of tailing areas. As a result of the research there is a proposal to continue the environmental observations due to increased metal contents, exceeding the standard limits, in the surroundings of the tailing areas.

### 0430 Transport, Handling, and Storage

**33720** **Pipeline conditioning process for mined oil-sand.** Cymerman, G.J.; Leung, A.H. 11 May 1991. Filed date 10 Nov 1989. Canada Patent patent application 2029795. 31p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

Mined oil sand is mixed at the mine site with heated water and a process aid, typically NaOH, to produce a slurry. The slurry is pumped through a pipeline directly to a gravity separation vessel for recovery by spontaneous flotation of contained bitumen in the form of froth. In the course of being pumped through the pipeline, the bitumen is conditioned, that is, bitumen is liberated from the solids and dispersed in the water as oil flecks. The oil flecks coalesce into larger globules, and the globules contact air bubbles entrained in the slurry and become aerated. The aerated bitumen globules are sufficiently buoyant to undergo spontaneous flotation and formation of froth when retained under quiescent conditions. Bitumen coalescence and aeration are complete after travelling a distance on the order of 2.5 km in the pipeline. If the slurry is pumped further than 2.5 km, no detrimental effects to the downstream process of bitumen recovery have been noted. 7 figs.

## 05 NUCLEAR FUELS

*Refer also to citation(s) 34110*

**33721** (DUH–12040) **Check list of W problems.** Squires, L. Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept. 10 Dec 1943. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000300. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a check list of problems submitted to cover information needed for the design and operation of the Hanford plant which should be obtainable from the experimental and manufacturing program at Oak Ridge.

### 0504 Feed Processing

*Refer also to citation(s) 33756, 33807, 34771, 34773*

### 0505 Uranium Enrichment

*Refer also to citation(s) 33732, 33733, 34856*

**33722** (POEF-T–3565) **Reuse of activated alumina.** Hobensack, J.E. Portsmouth Gaseous Diffusion Plant, OH (United States). 16 Aug 1991. 2p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. (CONF-9110117–5: 2. international conference on uranium hexafluoride handling, Oak Ridge, TN (United States), 29-31 Oct 1991). Order Number DE91018897. Source: OSTI; NTIS; INIS; GPO Dep.

Activated alumina is used as a trapping media to remove trace quantities of $UF_6$ from process vent streams. The current uranium recovery method employs concentrated nitric acid which destroys the alumina pellets and forms a sludge which is a storage and disposal problem. A recently developed technique using a distilled water rinse followed by three dilute acid rinses removes on average 97% of the uranium, and leaves the pellets intact with crush strength and surface area values comparable with new material. Trapping tests confirm the effectiveness of the recycled alumina as $UF_6$ trapping media. 2 tabs.

**33723** (Y/TR–90/13) **Crucible for uranium dissolution.** Tsubota, Motoji (Toshiba, Inc., Kanagawa (Japan)); Tajima, Koichi; Ito, Yoshimichi; Takahashi, Masanori. Oak Ridge Y-12 Plant, TN (United States). [1990]. 11p. Translation of Japanese Patent Application 63-243679, filed March 30, 1987, published October 11, 1988. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91018437. Source: OSTI; NTIS; GPO Dep.

The invention proposes a crucible for uranium dissolution that is capable of a large capacity and one in which deformities and damage based on its size have been eliminated. Molten uranium leakage is not a problem even though the crucible is constructed of split plates.

### 0507 Fuels Production and Properties

*Refer also to citation(s) 34002, 34014, 34043, 34044, 34068, 34076, 34082, 34085, 34086, 34096, 34097, 34098, 34200, 34785, 34788*

**33724** (DOE/ER/12823–2) **Measurement of uranium and plutonium content in a fuel assembly using the RPI spent fuel assay device: Final report.** Abdurrahman, N.; Block, R.C.; Harris, D.R.; Lee, Y.D.; Rodriguez-Vera, F.; Slovacek, R.E.; Werner, C.N. Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Nuclear Engineering and Engineering Physics. 2 Aug 1991. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-88ER12823. Order Number DE92000024. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document is the final report on the program entitled "Fissile Assay of Spent Fuel Using A Slowing-Down-Time Device." The objectives of the program are reviewed first and are then followed by the principle of operation of the slowing-down-time spectrometer assay device and the RPI prototype of this device. The experimental results and analysis are presented next. The design of the spent fuel assay station is then described. Finally, this project is summarized.

### 0508 Spent Fuels Reprocessing

*Refer also to citation(s) 33724, 33763, 33813, 34594, 34596, 34598*

33725 (CONF-910852–3-Extd.Abst.) **Overview of a continuous rotary dissolver concept with concentration on motor control and fabrication techniques.** Ladd, L.D.; Abston, R.A. Oak Ridge National Lab., TN (United States). Jun 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Summer national meeting of the American Institute of Chemical Engineers (AIChE); Pittsburgh, PA (United States); 20-22 Aug 1991. Order Number DE91017693. Source: OSTI; NTIS; GPO Dep.

A joint agreement between the Power Reactor and Nuclear Fuel Development Corporation of Japan and the US Department of Energy to develop breeder reactor fuel reprocessing technology has resulted in a project to design, fabricate, and test a continuous rotary dissolver and associated systems. The continuous rotary dissolver provides the functions to react oxide fuels with nitric acid during the dissolution process. Design requirements dictated that welding be restricted to a minimum, that the dissolver would be remotely maintainable, that the drive system must be controlled for stage transfer and agitation, and that bearing/seal performance must be an improvement from previous designs. Welding was virtually eliminated by machining the helical auger from a 4960-kg (11,000-lb) forging, then shrink fitting a centrifugal casting to the auger. Remote maintenance requirements were achieved by utilizing module design, specifically a unique bearing/seal/taper coupling assembly. Ceramic bearings were selected, fabricated, and installed, non-lubricatable. The drive unit and its control system were tested and programmed to transfer solids and liquids, while providing agitation to assist the dissolution process. The drive control provides angular feedback from a radiation-hardened resolver. Fabrication was accomplished on schedule and within projected costs. Installation has been completed and the dissolver is now being tested at the Oak Ridge National Laboratory.

33726 (JAERI-M–91-091) **Comparative evaluation by STAR code with source term models used in solution heating and boiling for reprocessing facility.** Nomura, Yasushi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 48p. (In Japanese). Order Number DE92713860. Source: OSTI; NTIS (US Sales Only); INIS.

It is vital for safety assessment of reprocessing facilities to precisely predict generation of aerosol particles, their density and size distribution in the case of accidental solution heating and boiling. In this report, several source term models for use in the safety assessment are reviewed and summarized, resorting to relevant published documents, with necessary methods and data sorted and described. Furthermore, an example case of loss of cooling accident in HALW (High Activity Liquid Waste) tanks of a typical reprocessing facility is analysed with the STAR code, to illustrate how to use these models and data in the safety assessment. This example analysis includes two cases, one for the solution vaporization model and the other for the bubble burst model, with respect to different mechanism of aerosol generation from liquid surface. As a result of the analysis, it is shown for the solution vaporization model, generating sub-micron range liquid drop aerosol, to be more important to predict accurate dose rate committed by the public. (author).

33727 (LA–12149-MS) **Use of process monitoring for verifying facility design for large-scale reprocessing plants.** Ehinger, M.H. (Oak Ridge National Lab., TN (United States)); Zack, N.R.; Hakkila, E.A.; Franssen, F. Los Alamos National Lab., NM (United States). Aug 1991. 49p. Sponsored by US Program for Technical Assistance (United States). DOE Contract W-7405-ENG-36. (ISPO–331;ORNL/TM–11856). Order Number DE91017670. Source: OSTI; NTIS; INIS; GPO Dep.

During the decade of the 1990s, the International Atomic Energy Agency faces the challenge of implementing safeguards in large, new reprocessing facilities. The Agency will be involved in the design, construction, checkout, and initial operation of these new facilities to ensure effective safeguards are implemented. One aspect of the Agency involvement is in the area of design verification. The US Support Program has initiated a task to develop methods for applying process data collection and validation during the cold commissioning phase of plant construction. This paper summarizes the results of this task. 23 refs., 9 figs., 1 tab.

33728 (WHC-MR–0187) **Air pulsed plate liquid-liquid extractor simulation.** Barrington, C.A. Westinghouse Hanford Co., Richland, WA (United States). May 1991. 434p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE91018155. Source: OSTI; NTIS; GPO Dep.

A simulation of bulk fluid behavior in pneumatically pulsed sieve-plate columns is developed primarily through application of fundamental concepts in thermodynamics and fluid mechanics. The simulation allows estimation of the time variation of many basic parameters such as gas and liquid pressures and positions of liquid interfaces. The simulation includes sufficient detail to allow use as an aid to the design of pneumatic pulse columns. An open system and adiabatic gas dynamics are assumed. A new pulse leg design is proposed and included in the mathematical development of the stimulation. The use of the simulation as an aid in designing a pulse leg for a hypothetical column is demonstrated. This entire work has been developed solely for the purpose of satisfying requirements for the degree of Master of Science in Chemical Engineering for the University of Washington in Seattle, Washington. 36 refs., 56 figs., 8 tabs.

33729 (WHC-SA–1170) **Silver-catalyzed $PuO_2$ dissolution with persulfate.** Fisher, F.D.; Barney, G.S.; Cooper, T.D.; Duchsherer, M.J. Westinghouse Hanford Co., Richland, WA (United States). Jun 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-9106203–6: 15. actinide separations conference, Charleston, SC (United States), 17-21 Jun 1991). Order Number DE91018153. Source: OSTI; NTIS; INIS; GPO Dep.

This report consists of 14 slides and associated narrative for a presentation to be given at the 15th Annual Actinide Separations Conference on silver-catalyzed $PuO_2$ dissolution with persulfate. (JL)

33730 (Y/TR–91/2) **Centrifugal extractor.** Hata, Kenji (Toshiba Corp., Tokyo (Japan)). Oak Ridge Y-12 Plant, TN (United States). [1991]. 18p. Translation of Japanese Patent Application Hei 2[1990]-119902, filed October 27, 1988, published May 8, 1990. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91018482. Source: OSTI; NTIS; GPO Dep.

This invention concerns a type of centrifugal extractor for performing solvent extraction of uranium or plutonium from the uranium or plutonium solution in a nuclear fuel reprocessing plant, etc. The centrifugal extractor is characterized by the following features: it has a rotating shaft passing through a shielding slab;on the lower end of the slab, a rotating bowl is installed; a frame is set on the upper surface of said slab; a motor is set on the frame and it rotates said rotating bowl via said rotating shaft; the lower end of said rotating bowl, a pump mechanism for suction of the heavy liquid phase and a pump mechanism for suction of the light liquid phase are arranged concentrically to each other; within said rotating bowl, a multistage mixing/extracting chamber for performing countercurrent mixing and extraction of said heavy liquid phase and light liquid phase is arranged; extracted light liquid phase and heavy liquid phase outlets are arranged on the mixing/extracting chamber. 6 figs.

33731 (Y/TR–91/9) **Studies of the conversion chemistry of plutonium and uranium in nitrate and carbonate systems.** Hoffmann, G. (Muenchen Univ. (Germany). Inst. fuer Anorganische Chemie); Steinhauser, M.; Boehm, M. Oak Ridge Y-12 Plant, TN (United States); Muenchen Univ. (Germany). Inst. fuer Anorganische Chemie. [1991]. 35p. Translation of INIS-mf–11999, 1988. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91018517. Source: OSTI; NTIS; GPO Dep.

In the present research project the goal was first to develop further a pressure dissolution process for plutonium dioxide that had already proved successful, with the aid of making greater throughputs possible. The next objective was to find a possibility for separating out americium 241, which also goes into solution during

dissolution of $PuO_2$ in nitric acid and is formed from plutonium 241, as well as foreign metal cations stemming from the cladding and vessel materials. The oxidation of solutions of nitric acid and plutonium by means of ozone to form Pu(6) needed to be optimized – primarily as regarded the time duration. In order to guarantee safe handling (transport and storage) of plutonium nitrate and uranium/plutonium nitrate solutions, a further goal was to acquire sufficient knowledge about the dissolution behavior of these heavy metal nitrates. 14 figs., 3 tabs.

## 0509 Transport, Handling, and Storage

*Refer also to citation(s) 33746, 34784, 34795, 34796*

**33732** (POEF-T–3566) **Cracked lifting lug welds on ten-ton $UF_6$ cylinders.** Dorning, R.E. II. Portsmouth Gaseous Diffusion Plant, OH (United States). 16 Aug 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. (CONF-9110117–4: 2. international conference on uranium hexafluoride handling, Oak Ridge, TN (United States), 29-31 Oct 1991). Order Number DE91018899. Source: OSTI; NTIS; INIS; GPO Dep.

Ten-ton, Type 48X, $UF_6$ cylinders are used at the Portsmouth Gaseous Diffusion Plant to withdraw enriched uranium hexafluoride from the cascade, transfer enriched uranium hexafluoride to customer cylinders, and feed enriched product to the cascade. To accomplish these activities, the cylinders are lifted by cranes and straddle carriers which engage the cylinder lifting lugs. In August of 1988, weld cracks on two lifting lugs were discovered during preparation to lift a cylinder. The cylinder was rejected and tagged out, and an investigating committee formed to determine the cause of cracking and recommend remedial actions. Further investigation revealed the problem may be general to this class of cylinder in this use cycle. This paper discusses the actions taken at the Portsmouth site to deal with the cracked lifting lug weld problem. The actions include inspection activities, interim corrective actions, metallurgical evaluation of cracked welds, weld repairs, and current monitoring/inspection program. 4 figs.

**33733** (POEF-T–3567) **Temporary patching of damaged $UF_6$ cylinders.** Cardenas, A.L. Portsmouth Gaseous Diffusion Plant, OH (United States). 16 Aug 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. (CONF-9110117–3: 2. international conference on uranium hexafluoride handling, Oak Ridge, TN (United States), 29-31 Oct 1991). Order Number DE91018898. Source: OSTI; NTIS; INIS; GPO Dep.

Patching techniques based on application of epoxy resins have been developed for temporarily repairing $UF_6$ cylinders which have sustained relatively minor damage and must be safely emptied. The method is considerably faster and simpler than metallurgical weld repairs. Laboratory tests, detailed operational procedures, and case histories of experience at the Portsmouth Gaseous Diffusion Plant are described. 2 figs.

## 0510 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 33740, 33741, 33742, 33743, 33744, 33745*

## 0520 Waste Management

*Refer also to citation(s) 33802, 33804, 33805, 33819, 33910, 34001, 34018, 34066, 34067, 34069, 34071, 34072, 34073, 34074, 34075, 34079, 34080, 34081, 34083, 34084, 34086, 34087, 34088, 34089, 34090, 34091, 34092, 34093, 34094, 34095, 34212, 34397, 34581, 34598, 34780, 34783, 34861, 34936, 35026, 35032, 35052, 35054, 35059, 35075, 35081, 35443, 35565*

**33734** (ANL/CP–73026) **R&D activities at DOE applicable to mixed waste.** Erickson, M.D.; Devgun, J.S.; Brown, J.J.; Beskid, N.J. Argonne National Lab., IL (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9110207–1: HazMat South '91 (Hazardous materials management conference), Atlanta, GA (United States), 2-4 Oct 1991). Order Number DE91018561. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy (DOE) has established the Office of Environmental Restoration and Waste Management. Within the new organization, the Office of Technology Development (OTD) is responsible for research, development, demonstration, testing and evaluation (RDDT&E) activities aimed at meeting DOE cleanup goals, while minimizing cost and risk. Because of US governmental activities dating back to the Manhattan project, mixed radioactive and hazardous waste is an area of particular concern to DOE. The OTD is responsible for a number of R&D activities aimed at improving capabilities to characterize, control, and properly dispose of mixed waste. These activities and their progress to date will be reviewed. In addition, needs for additional R&D on managing mixed waste will be presented. 5 refs., 2 tabs.

**33735** (BNL–46359) **Long-term durability of polyethylene for encapsulation of low-level radioactive, hazardous, and mixed wastes.** Kalb, P.D.; Heiser, J.H.; Colombo, P. Brookhaven National Lab., Upton, NY (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-911071–4: American Chemical Society symposium on emerging technologies for hazardous waste management, Atlanta, GA (United States), 1-3 Oct 1991). Order Number DE92000486. Source: OSTI; NTIS; INIS; GPO Dep.

The durability of polyethylene waste forms for treatment of low-level radioactive, hazardous, and mixed wastes is examined. Specific potential failure mechanisms investigated include biodegradation, radiation, chemical attack, flammability, environmental stress cracking, and photodegradation. These data are supported by results from waste form performance testing including compressive yield strength, water immersion, thermal cycling, leachability of radioactive and hazardous species, irradiation, biodegradation, and flammability. Polyethylene was found to be extremely resistant to each of these potential failure modes under anticipated storage and disposal conditions. 16 refs., 3 figs., 1 tab.

**33736** (DOE/CH/10378–9) **Analysis of well test data—Application of probabilistic models to infer hydraulic properties of fractures.** Osnes, J.D. (RE/SPEC, Inc., Rapid City, SD (United States)); Winberg, A.; Andersson, J.E.; Larsson, N.A. RE/SPEC, Inc., Rapid City, SD (United States). 27 Sep 1991. 161p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-89CH10378. (RSI–0338). Order Number DE92000030. Source: OSTI; NTIS; INIS; GPO Dep.

Statistical and probabilistic methods for estimating the probability that a fracture is nonconductive (or equivalently, the conductive-fracture frequency) and the distribution of the transmissivities of conductive fractures from transmissivity measurements made in single-hole injection (well) tests were developed. These methods were applied to a database consisting of over 1,000 measurements made in nearly 25 km of borehole at five sites in Sweden. The depths of the measurements ranged from near the surface to over 600-m deep, and packer spacings of 20- and 25-m were used. A probabilistic model that describes the distribution of a series of transmissivity measurements was derived. When the parameters of this model were estimated using maximum likelihood estimators, the resulting estimated distributions generally fit the cumulative histograms of the transmissivity measurements very well. Further, estimates of the mean transmissivity of conductive fractures based on the maximum likelihood estimates of the model's parameters were reasonable, both in magnitude and in trend, with respect to depth. The estimates of the conductive fracture probability were generated in the range of 0.5–5.0 percent, with the higher values at shallow depths and with increasingly smaller values as depth increased. An estimation procedure based on the probabilistic model and the maximum likelihood estimators of its parameters was recommended. Some guidelines regarding the design of injection test programs were drawn from the recommended estimation procedure and the parameter estimates based on the Swedish data. 24 refs., 12 figs., 14 tabs.

**33737** (DOE/ER/60615–T1) **Control of water infiltration at humid area shallow land burial facilities: Progress report for FY 89.** Lunt, O.R.; Schulz, R.K. California Univ., Los Angeles, CA (United States). Lab. of Biomedical and Environmental Sciences. Feb 1990. 12p. Sponsored by USDOE, Washington, DC (United

States). DOE Contract FC03-87ER60615. Order Number DE91018946. Source: OSTI; NTIS; INIS; GPO Dep.

Three kinds of waste disposal unit covers or barriers to water infiltration are being investigated. They are: (1) resistive layer barrier, (2) conductive layer barrier, and (3) bioengineering management. The resistive layer barrier consists of compacted earthern material (e.g. clay). The conductive layer barrier consists of a conductive layer in conjunction with a capillary break. As long as unsaturated flow conditions are maintained the conductive layer will wick water around the capillary break. Below grade layered covers such as (1) and (2) will fail if there is appreciable subsidence of the cover. Remedial action for this kind of failure will be difficult. A surface cover, called bioengineering management, is meant to overcome this problem. The bioengineering management surface barrier is easily repairable if damaged by subsidence; therefore, it could be the system of choice under active subsidence conditions. The bioengineering management procedure also has been shown to be effective in dewatering saturated trenches and could be used for remedial action efforts. After cessation of subsidence, that procedure could be replaced by a resistive layer barrier, or perhaps even better, a resistive layer barrier/conductive layer barrier system. This latter system would then give long-term effective protection against water entry to waste and without institutional care. These various concepts are being assessed in six large (70 in. x 45 in. x 10 in. each) lysimeters at Beltsville, Maryland. 6 refs., 21 figs.

33738 (DOE/HWP–106-Vol.2) **An assessment of thermal destruction technologies for application to Department of Energy mixed wastes: Volume 2, Technology data sheets.** Oak Ridge K-25 Site, TN (United States); Science Applications International Corp., Idaho Falls, ID (United States). Waste Management Technology Div. Aug 1991. 150p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE91018446. Source: OSTI; NTIS; INIS; GPO Dep.

A study of known operational and emerging thermal treatment technologies was conducted for the Department of Energy's (DOE's) Office of Technology Development (OTD) through the Hazardous Waste Remedial Actions Program (HAZWRAP). This study addressed thermal treatment of mixed wastes (MWs), for which the most comprehensive set of waste has been divided into two volumes. Volume 1 contains the details and results of the technology assessments and comparisons between technologies. This volume (Volume 2) contains the comprehensive data collected on each technology, including descriptions, process and cost data, comments on advantages and deficiencies, types of waste treatable and by-products of these wastes, and reference information. 2 figs.

33739 (DOE/ID–10333) **US Department of Energy Idaho Operations Office Waste Minimization and Pollution Prevention Awareness Plan.** EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1991. 119p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (MISC–91079). Order Number DE91018761. Source: OSTI; NTIS; INIS; GPO Dep.

This document provides a waste minimization plan pursuant to DOE Orders 5400.1, General Environmental Protection Program, 5400.3, Hazardous and Radioactive Mixed Waste Program, and 5820.2A, Radioactive Waste Management. The implementation guidance for Order 5400.1 establishes a general waste reduction program consolidating the above DOE orders and requires DOE's Idaho operation office (DOE-ID) to issue a Waste Minimization Plan for all operating facilities and sites under DOE-ID's purview. These sites include Idaho National Engineering Laboratory (INEL). Component Development and Integration Facility, Grand Junction Project Office, and West Valley Development Project. The overall objective of this Pollution Prevention Program is to implement waste minimization practices to achieve a realistic reduction in the total generation of wastes. This plan for reduction in quantity and toxicity of wastes provides a baseline for the implementation of the DOE-ID Pollution Prevention Program. Waste minimization and Pollution Prevention Awareness Programs are both included. The organization of the program at each level and each level's minimization functions are provided. Functions include planning, training, program implementation, reporting, auditing, waste tracking, and program evaluation. Recommendations for improving the current database and the current waste tracking methodology are discussed. A proposed waste assessment procedure for characterizing wastes and examining the available waste minimization options is presented. INEL uses several methods of technology transfer to facilitate the exchange of possible waste minimization techniques. The basis for a program assessment methodology provides for investigation into the effectiveness of the minimization techniques, budget and management as well as product and service quality.

33740 (DOE/JIO–005) **FY 1986 current fiscal year work plan.** USDOE Joint Integration Office, Albuquerque, NM (United States); Rockwell International Corp., Albuquerque, NM (United States). Joint Integration Office; Westinghouse Electric Corp., Albuquerque, NM (United States). Joint Integration Office. Nov 1985. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE92000929. Source: OSTI; NTIS; GPO Dep.

This Current Year Work Plan presents in detail a description of the activities to be performed by the Joint Integration Office/RI during FY86. It breaks down the activities into two major work areas: Program Management and Program Analysis. Program Management is performed by the JIO/RI by providing technical planning and guidance for the development of advanced TRU waste management capabilities. This includes equipment/facility design, engineering, construction, and operations. These functions are integrated to allow transition from interim storage to final disposition. JIO/RI tasks include program requirements identification, long-range technical planning, budget development, program planning document preparation, task guidance development, task monitoring, task progress information gathering and reporting to DOE, interfacing with other agencies and DOE lead programs, integrating public involvement with program efforts, and preparation of reports for DOE detailing program status. Program Analysis is performed by the JIO/RI to support identification and assessment of alternatives, and development of long-term TRU waste program capabilities. These analyses include short term analyses in response to DOE information requests, along with performing an RH Cost/Schedule Optimization report. System models will be developed, updated, and upgraded as needed to enhance JIO/RI's capability to evaluate the adequacy of program efforts in various fields. A TRU program data base will be maintained and updated to provide DOE with timely responses to inventory related questions.

33741 (DOE/JIO–006) **Fiscal year 1986 program plan for the Defense Transuranic Waste Program (DTWP).** USDOE Joint Integration Office, Albuquerque, NM (United States); Rockwell International Corp., Albuquerque, NM (United States). Joint Integration Office; Westinghouse Electric Corp., Albuquerque, NM (United States). Joint Integration Office. Nov 1985. 126p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE92000931. Source: OSTI; NTIS; GPO Dep.

The Defense TRU Waste Program (DTWP) is the focal point for the Department of Energy is national planning, integration, and technical development for TRU waste management. The scope of this program extends from the point of TRU waste generation through delivery to a permanent repository. The TRU program maintains a close interface with repository development to ensure program compatibility and coordination. The defense TRU program does not directly address commercial activities that generate TRU waste. Instead, it is concerned with providing alternatives to manage existing and future defense TRU wastes. The FY 86 Program Plan is consistent with the Defense TRU Waste Program goals and objectives stated in the Defense Transuranic Waste Program Strategy Document, January 1984. The roles of participants, the responsibilities and authorities for Research & Development (R&D), the organizational interfaces and communication channels for R&D and the establishment of procedures for planning, reporting, and budgeting of all R&D activities meet requirements tated in the Technical Management Plan for the Transuranic Waste Management Program. The Program Plan is revised as needed. Detailed budget planning (i.e., programmatic funding and capital equipment) is presented for FY 86; outyear budget projections are presented for future years.

**33742** (DOE/JIO–019) **FY 1987 current fiscal year work plan.** USDOE Joint Integration Office, Albuquerque, NM (United States); Rockwell International Corp., Albuquerque, NM (United States). Joint Integration Office; Westinghouse Electric Corp., Albuquerque, NM (United States). Joint Integration Office. Dec 1986. 68p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE92000872. Source: OSTI; NTIS; INIS; GPO Dep.

This Current Year Work Plan presents a detailed description of the activities to be performed by the Joint Integration Office during FY87. It breaks down the activities into two major work areas: Program Management and Program Analysis. Program Management is performed by the JIO by providing technical planning and guidance for the development of advanced TRU waste management capabilities. This includes equipment/facility design, engineering, construction, and operations. These functions are integrated to allow transition from interim storage to final disposition. JIO tasks include program requirements identification, long-range technical planning, budget development, program planning document preparation, task guidance, task monitoring, information gathering and task reporting to DOE, interfacing with other agencies and DOE lead programs, integrating public involvement with program efforts, and preparation of program status reports for DOE. Program Analysis is performed by the JIO to support identification and assessment of alternatives, and development of long-term TRU waste program capabilities. This work plan includes: system analyses, requirements analyses, interim and procedure development, legislative and regulatory analyses, dispatch and traffic analyses, and data bases.

**33743** (DOE/JIO–020) **Fiscal year 1987 program plan.** USDOE Joint Integration Office, Albuquerque, NM (United States); Rockwell International Corp., Albuquerque, NM (United States). Joint Integration Office; Westinghouse Electric Corp., Albuquerque, NM (United States). Joint Integration Office. Dec 1986. 131p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE92000877. Source: OSTI; NTIS; INIS; GPO Dep.

The Defense TRU Waste Program (DTWP) is the focal point for the Department of Energy in national planning, integration, operation, and technical development for TRU waste management. The scope of this program extends from the point of TRU waste generation through delivery to a permanent repository. The TRU program maintains a close interface with repository development to ensure program compatibility and coordination. The defense TRU program does not directly address commercial activities that generate TRU waste. Instead, it is concerned with providing alternatives to manage existing and future defense TRU wastes. The FY 87 Program Plan is consistent with the Defense TRU Waste Program goals and objectives stated in the Defense Transuranic Waste Program Strategy Document, January 1984. The roles of participants, the responsibilities and authorities for Operations, and Research & Development (R&D), the organizational interfaces and communication channels for R&D and the establishment of procedures for planning, reporting, and budgeting of Operations and R&D activities meet requirements stated in the Technical Management Plan for the Transuranic Waste Management Program. Detailed budget planning (i.e., programmatic funding and capital equipment) is presented for FY 87; outyear budget projections are presented for future years.

**33744** (DOE/JIO–021) **Reduced waste generation technical work plan.** USDOE Joint Integration Office, Albuquerque, NM (United States); Rockwell International Corp., Albuquerque, NM (United States). Joint Integration Office; Westinghouse Electric Corp., Albuquerque, NM (United States). Joint Integration Office. May 1987. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. Order Number DE92000930. Source: OSTI; NTIS; INIS; GPO Dep.

The United States Department of Energy has established policies for avoiding plutonium losses to the waste streams and minimizing the generation of wastes produced at its nuclear facilities. This policy is evidenced in DOE Order 5820.2, which states "Technical and administrative controls shall be directed towards reducing the gross volume of TRU waste generated and the amount of radioactivity in such waste." To comply with the DOE directive, the Defense Transuranic Waste Program (DTWP) supports and provides funding for specific research and development tasks at the various DOE sites to reduce the generation of waste. This document has been prepared to give an overview of current and past Reduced Waste Generation task activities which are to be based on technical and cost/benefit factors. The document is updated annually, or as needed, to reflect the status of program direction. Reduced Waste Generation (RWG) tasks encompass a wide range of goals which are basically oriented toward (1) avoiding the generation of waste, (2) changing processes or operations to reduce waste, (3) converting TRU waste into LLW by sorting or decontamination, and (4) reducing volumes through operations such as incineration or compaction.

**33745** (DOE/JIO–024) **Proceedings of the second FY87 meeting of the National Working Group for Reduction in Transuranic Waste Arisings.** USDOE Joint Integration Office, Albuquerque, NM (United States); Rockwell International Corp., Albuquerque, NM (United States). Joint Integration Office; Westinghouse Electric Corp., Albuquerque, NM (United States). Joint Integration Office. Sep 1987. 124p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-86AL31950. (CONF-8707230–Summ.: 2. Meeting of the National Working Group for Reduction in Transuranic Waste Arisings (NWGRTWA), Livermore, CA (United States), 28-29 Jul 1987). Order Number DE92000881. Source: OSTI; NTIS; INIS; GPO Dep.

The Second FY87 Meeting of the National Working Group for Reduction in Transuranic Waste Arisings (NWGRTWA) was held at the Lawrence Livermore National Laboratory, Tuesday and Wednesday, July 28–29, 1987. The purpose of the meeting was to discuss (1) modeling programs for waste reduction, (2) proposed FY88 and out-year tasks including the SRL Pu incineration, immobilization improvement, erbia coating technology, and (3) improvements in up-stream recovery operations to effect waste reduction. In addition, tours were made of the LLNL Waste Operations, the Laser Fusion (NOVA), and the Magnetic Fusion (MFTF).

**33746** (DOE/LLW–132) **1990 State-by-State assessment of low-level radioactive wastes received at commercial disposal sites: National Low-Level Waste Management Program.** Fuchs, R.L.; Culbertson-Arendts, K. EG and G Idaho, Inc., Idaho Falls, ID (United States). Sep 1991. 152p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE92000224. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

Each year the National Low-Level Waste Management Program publishes a state-by-state assessment report. This annual report provides both national and state-specific disposal data on low-level radioactive wastes. Data in this report are categorized according to disposal site, generator category, waste class, volume, and activity. Included in this report are tables showing a distribution of wastes by state for 1990 and a comparison of waste volumes by state for 1986 through 1990; also included is a list of all commercial nuclear power reactors in the United States as of December 31, 1990. In this year's report, a distinction has been made between low-level radioactive waste shipped directly by generators for disposal and that which was handled by an intermediary. 5 refs., 4 tabs.

**33747** (DOE/NV–345) **Tritium migration studies at the Nevada Test Site.** Schulz, R.K. (California Univ., Berkeley, CA (United States)); Romney, E.M.; Fujii, L.M.; Greger, P.D.; Kendall, E.W.; Hunter, R.B. California Univ., Berkeley, CA (United States). Aug 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-89NV10755. Order Number DE92000278. Source: OSTI; NTIS; INIS; GPO Dep.

Emanation of tritium from waste containers is a commonly known phenomenon. Release of tritium from buried waste packages was anticipated, therefore a research program was developed to study both the rate of tritium release from buried containers and subsequent migration of tritium through soil. Migration of tritium away from low level radioactive wastes buried in Area 5 of the Nevada Test Site was studied. Four distinct disposal events were investigated. The oldest burial event studied was a 1976 emplacement of 3.5 million curies of tritium in a shallow land burial trench. Tritium transport to the atmosphere by plant transpiration was determined

to have risen sharply with the passage of time, and is now occurring at the rate of about 6 curies per year. The tritium being released from this waste has not resulted in elevated tritium levels in the urine of people working directly on the trench cap. Air samplers placed around the perimeter of the Area 5 site show no higher tritium levels than the Nevada Test Site in general. In another event, 248 thousand curies of tritium was disposed of in an overpack emplaced 6 meters below the floor of a low-level waste disposal pit. Measurement of the emanation rate of tritium out of 55 gallon drums to the overpack was studied, and an annual doubling of the emanation rate over a seven year period was found. No evidence of significant migration of tritium away from the overpack was found. In a third study, upward tritium migration in the soil was observed in a greater confinement disposal test. The movement was suspected largely to be the result of experimental anomalies and heat generated by other radionuclides present in the waste. Releases of tritium to the atmosphere were found to be insignificant. The fourth event consisted of burial of 2.2 million curies of tritium in a greater confinement disposal operation. No significant migration was found. 4 refs., 4 figs., 6 tabs.

**33748** (DOE/RW–0043-Rev.4) **Program Management System Manual: Revision 4.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). Jul 1991. 160p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI; OSTI (Free of Charge); INIS.

The Office of Civilian Radioactive Waste Management OCRWM has developed a program management system (PMS) to assist in organizing, planning, directing and controlling the Civilian Radioactive Waste Management Program. A well defined management system is necessary because: (1) the Program is a complex technical undertaking with a large number of participants, (2) the disposal and storage facilities to be developed by the Program must be licensed by the Nuclear Regulatory Commission (NRC) and hence are subject to rigorous quality assurance (QA) requirements, (3) the legislation mandating the Program creates a dichotomy between demanding schedules of performance and a requirement for close and continuous consultation and cooperation with external entities. (4) the various elements of the Program must be managed as parts of an integrated waste management system, (5) the Program has an estimated total system life cycle cost of over $30 billion, and (6) the Program has a unique fiduciary responsibility to the owners and generators of the nuclear waste for controlling costs and minimizing the user fees paid into the Nuclear Waste Fund. This PMS Manual is designed and is structured to facilitate strong, effective Program management by providing policies and requirements for organizing, planning, directing and controlling the major Program functions. 58 refs., 12 figs., 2 tabs.

**33749** (DOE/RW–0074) **A multiattribute utility analysis of sites nominated for characterization for the first radioactive-waste repository: A decision-aiding methodology.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (United States). May 1986. 482p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge); INIS.

In December 1984, the Department of Energy (DOE) published draft environmental assessments (EAs) to support the proposed nomination of five sites and the recommendation of three sites for characterization for the first radioactive-waste repository. A chapter common to all the draft EAs (Chapter 7) presented rankings of the five sites against the postclosure and the preclosure technical siting guidelines. To determine which three sites appeared most favorable for recommendation for characterization, three simple quantitative methods were used to aggregate the rankings assigned to each site for the various technical guidelines. In response to numerous comments on the methods, the DOE has undertaken a formal application of one of them (hereafter referred to as the decision-aiding methodology) for the purpose of obtaining a more rigorous evaluation of the nominated sites. The application of the revised methodology is described in this report. The method of analysis is known as multiattribute utility analysis; it is a tool for providing insights as to which sites are preferable and why. The decision-aiding methodology accounts for all the fundamental considerations specified by the siting guidelines and uses as source information the data and evaluations reported or referenced in the EAs. It explicitly addresses the uncertainties and value judgments that are part of all siting problems. Furthermore, all scientific and value judgments are made explicit for the reviewer. An independent review of the application of the decision-aiding methodology has been conducted by the Board on Radioactive Waste Management of the National Academy of Sciences; the comments of the Board are included as an appendix to this report.

**33750** (EGG-WTD–9780) **Test plan for cryofracture demonstration, sampling, and analysis.** Osborne, D.; Winberg, M. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jul 1991. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018833. Source: OSTI; NTIS; INIS; GPO Dep.

This test plan defines basic test procedures for demonstrating the applicability of cryofracture techniques for size reduction of wastes at the Idaho National Engineering Laboratory (INEL). To demonstrate the cryofracture process, drums and boxes with simulated waste will be cryogenically cooled and then fractured in a hydraulic press. The cryofracture process was originally developed for the demilitarization of chemical and biological munitions. It is expected that cryofracture will provide a safe, simple, and reliable method of accessing and downsizing packaged wastes for subsequent treatment and disposal operations. The demonstration will include initial tests to determine rates of cryogenic cooling, cryofracture demonstration, characterization and documentation of cryofracture process end products, and a sampling program to simulate the extent of contamination dispersion during the cryofracture process. A description of test apparatus and test methods is provided in this plan. Quality assurance and safety requirements for this project are also identified. 9 figs., 7 tabs.

**33751** (EUR–12948) **Investigations on the melting of radioactive metallic parts of the KKN-installation in a controlled area.** Thoma, A. (NOELL GmbH, Wuerzburg (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1991. 13p. (In German). Contract FI1D-0043. Source: OSTI; NTIS (US Sales Only).

The melting plant for radioactive waste metals EIRAM is located in the premises of the decommissioned research reactor FR2 at the Kernforschungszentrum Karlsruhe. About 250 t of low radioactive (< 60 Bq/g) steel components from the decommissioned nuclear power plant of Niederaichbach (KKN) were melted in a controlled area in the period from June to November 1989. Co-60 and other ironlike nuclides remained, as expected, nearly completely in the ingot, whereas Cs-137 and Eu-152 concentrated in the slag. In spite of the short operation time, it was shown that a long-term operation of the melting plant would be possible without significant radiation exposure of the workforce. The main goal of the research contract, i.e. melting of 200 t of various higher contaminated steel wastes (200 Bq/g and 500 Bq/cm$^2$) was not reached, due to the premature decommissioning of the melting plant by the KfK (for economic reasons).

**33752** (EUR–13133) **Further studies on melting of radioactive metallic wastes from the dismantling of nuclear installations.** Diepenau, H. (Siempelkamp Giesserei GmbH Und Co., Krefeld (DE)); Seidler, M. Commission of the European Communities, Luxembourg (Luxembourg). 1991. 66p. (In German). Contract FI1D-0016. Source: OSTI; NTIS (US Sales Only).

Melting of radioactive waste metal from the dismantling/refurbishing of nuclear installations is an acceptable way for nuclear waste recycling. This material can be used for the casting of qualified products such as type A- and type B-waste containers. The results of the melting facility -TAURUS- were used to build the industrial scale melting facility -CARLA- at Siempelkamp. The test results and the longterm-behaviour of the facility showed that the licensing conditions can be respected. The radiation exposure of workers was in the range of the admissible limit for non-exposed people. The radiation exposure of the environment is far below the value of the German Radiation Protection Law. The activity distribution within the product is homogeneous, so that its activity can be measured exactly before it is sent back in the nuclear area. By melting waste copper it is possible to respect the specific limits for unrestricted reuse, whereas for brass the limit for conditioned reuse in the industrial field was reached. Radioactive carbon can

only be bound in form of small graphite lamellas or nodules in the cast iron; i.e. radioactive carbon can only be added to the melt as crushed material. During the research programme 2000 Mg of waste steel was melted at industrial scale and mainly products such as shielding blocks and waste containers were produced. 12 figs., 27 tabs., 6 refs.

**33753** (EUR–13253) **Prefiltration of gaseous effluents in plant dismantling.** Pilot, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept. de Protection Technique); Pourprix, M. Commission of the European Communities, Luxembourg (Luxembourg). 1991. 161p. (In French). Contract FI1D-0007 F. Source: OSTI; NTIS (US Sales Only).

The dismantling techniques and mainly the thermal cutting tools can create large amounts of airbone dust, possibly contaminated in the case of the cutting of radioactive materials. Among the secondary solid emissions, the aerosols constitute the most mobile part which can disseminate contamination in the cell where the cutting operation takes place and in the ventilation ducts up to the HEPA filters. An optimised prefiltration coupled with a captation device at the aerosol generating source allows to avoid the dissemination of the contamination, to increase the life of HEPA filters and thus to reduce the amount of solid wastes. The object in this work was to select one or several cleaning devices, selection that can be done from the knowledge of the physico-chemical characteristics of the gas and aerosols to deal with, the available cleaning devices and the implied facility.

**33754** (EUR–13318) **Development and testing of an electrochemical separation process for cutting activated steel components.** Stang, W. (Kernkraftwerke Betriebsgesellschaft mbH, Gundremmingen (DE)); Fischer, A.; Pott, P. Commission of the European Communities, Luxembourg (Luxembourg). 1991. 44p. (In German). Contract FI1D-0010. Source: OSTI; NTIS (US Sales Only).

Electrochemical decontamination has a great importance for the decommissioning works at KRB A. By this method the metal surface is slightly removed due to a galvanic process in an electrolytic solution. Using the same principle it is also possible to remove material locally (ECM-technique). Many advantages of this method indicated that it could be used for cutting activated steel during decommissioning of nuclear power plants. In the frame of this research contract, experiments with non-active material from a reactor pressure vessel were investigated. The essential results demonstrated - which procedures and cathodes are suitable for high cutting velocities - and which amount of sludge (waste) will be produced in the electrolyte. The research programme has been carried out in cooperation with AEG-Elotherm, Remscheid. The test facility, the execution as well as the evaluation of the experiments were made by AEG-Elotherm.

**33755** (EUR–13356) **Investigation of the dissipation of cutting byproducts during underwater dismantling of steel parts from nuclear installations in view of selection and optimization of filtering systems to separate cutting byproducts.** Bach, F.W. (Hannover Univ., (DE). Inst. fuer Werkstoffkunde); Haferkamp, H.; Steiner, H. Commission of the European Communities, Luxembourg (Luxembourg). 1991. 96p. (In German). Contract FI1D-0036. Source: OSTI; NTIS (US Sales Only).

Dismantling is necessary in the decommissioning of nuclear facilities. For reasons of high levels of radioactivity the structures of the primary circuit of boiling water- and pressurized water reactors have to be dismantled under water. There are different mechanical and thermal tools which might be used for this work. A selection of a tool for a given task has to consider not only the design and equipment of the tool but also the handling of the generated secondary waste. The aim of this research was to collect all generated cutting by-pro-ducts in air and water for underwater plasma arc cutting, as an example of a thermal cutting technique, and for underwater grinding, as an example of a mechanical cutting technique, to apply to various filter systems and to measure their efficiencies and finally make proposals for air and water filter systems appropriate for the cutting of radioactive materials.

**33756** (FMPC–2227) **Application of a structured light source to waste surface mapping in waste storage silos at Fernald, Ohio.** Jacoboski, D.L. (Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project); Selleck, C.B.; Burks, B.L.; DePiero, F.W.; Rowe, J.C. Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project. [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21600. (CONF-910981–6: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE91018558. Source: OSTI; NTIS; GPO Dep.

One of the highest priority remedial activities within the DOE complex is the remediation of the K-25 Silos at the Fernald Environmental Management Project (FEMP), Fernald, Ohio. The K-25 Silos are above ground and bermed, domed, steel reinforced concrete structures that were built in the early 1950s to store uranium raffinate residues from uranium. Two of the four silos, Nos. 1 and 2, contain a waste material that is rich in Radium 226 and, hence, generates unacceptable amounts of radon gas during the decay process. Silo No. 3 contains primarily dry metal oxide wastes. Silo No. 4 is empty and is being used as a cold test site for demonstrating newly developed technologies. Test results are to be integrated with storage tank remediation activities throughout the DOE complex. In this presentation, we describe the application of a Structured Light Source to obtain waste surface contour data prior to bentonite deposition as a baseline measurement, then subsequently obtain bentonite surface contour data after deposition. Therefore, the thickness of bentonite at any point along the waste surface will be determined by the difference of surface contour data. Development, demonstration, and in-field deployment of this technology was co- sponsored by the DOE Office of Technology Development and the DOE Environmental Restoration (ER) through the FEMP. The lead coordinator of the project was WEMCO with the proof-of-principle developed by Sandia National Laboratory (SNL) and with the Oak Ridge National Laboratory (ORNL) as the software developer and system integrator. 3 refs., 2 figs.

**33757** (FMPC–2238) **Proposed plan for vitrification demonstration of low-level radioactive wastes at the Fernald Environmental Management Project.** Gimpel, R.F. Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project. [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21600. (CONF-910981–14: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE91018817. Source: OSTI; NTIS; INIS; GPO Dep.

Glassware was made by the Romans several hundreds of years before Christ. Some of this glassware was discovered in ship wreckage at sea. The glassware has eroded less than $\frac{1}{2}$ mm over 2500 years. The erosion rate of the crude Roman glass in corrosive salt water implies that low-level radioactive wastes dissolved in molten glass should remain entombed in the glass for extremely long periods of time (10,000 years plus). The extremely low leach rate for such a glass should keep concentrations in the environment below all regulatory limits and by that provide protection of the environment indefinitely. Vitrification is considered, by many, as a most effective (if not the most effective) treatment method for disposal of radioactive and numerous inorganic hazardous wastes. However, vitrification of low-level radioactive wastes at large production/commercial rates has not been accomplished and needs to be demonstrated to justify selecting vitrification as a competitive alternative to other treatment methods. This paper describes a proposed plan to demonstrate vitrification of low-level radioactive wastes at the Fernald Site (FS) located near Cincinnati, Ohio. Demonstrations will progress from laboratory to on-site bench-scale, to a pilot size, then to full-sized vitrifiers (glass melters). The bench sized unit will mainly prove the process and develop glass mixes using various waste forms and glass formers. The pilot scale unit will evaluate and develop operational requirements and processes. 3 figs., 2 tabs.

**33758** (FMPC–2240) **Methodology for conducting a performance assessment of an engineered disposal facility.** Janke, R.C. (Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management

Project); Gimpel, R.F.; Janke, R.J. Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project. [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21600. (CONF-910981–13: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE91018818. Source: OSTI; NTIS; INIS; GPO Dep.

A performance assessment of an engineered disposal facility (EDF) or a waste storage facility (WSF) can be performed in such a way that the results are easily used to meet design, maintenance, and overall planning requirements. The information developed in a performance assessment can be applied to existing systems or new designs to provide the necessary information for evaluating cost, benefits, and risks posed to workers and the public. This paper describes a method for conducting a performance assessment on an EDF at the Fernald Site (FS) located near Cincinnati, Ohio. At the FS, the EDF has been renamed and is now called the Engineered Waste Management Facility (EWMF). 3 refs., 7 figs.

**33759** (GSF–12/91) **Performance assessment of confinements for medium-level and α-contaminated waste. PACOMA project. Rock salt option. Final report.** Hirsekorn, R.P (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Braunschweig (Germany). Abt. fuer Endlagersicherheit); Nies, A.; Rausch, H.; Storck, R. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Mar 1991. 304p. Contract EC FI1W/0044-D. (GSF-TL–7/91). Order Number DE92714639. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of the contribution to the PACOMA project is to develop and demonstrate procedures for radiological safety of repositories in salt domes. An analogue study is performed by the Netherlands Energy Research Foundation ECN, where alternative disposal concepts in different salt formations were investigated. It is discussed, how far appropriate choice of the repository design parameters can improve the whole systems. The research covers deterministic calculations for three scenarios, the normal evolution scenario with subrosion of the salt dome, the combined brine intrusion scenario with brine intrusion from brine pockets and via an anhydrite vein, and the human intrusion scenario of solution mining of a storage cavern. For the combined brine intrusion scenario alternative waste inventories, different disposal concepts, variants of the layout of dams and sealings are investigated, and results obtained from variations of parameter values are discussed. Additionally, comprehensive probabilistic calculations have been carried out with the help of a Monte-Carlo simulation. Results are discussed in form of an uncertainty analysis of the maximum dose and global sensitivity studies of system parameters. The assessments main result is, that the reference case, where the reference repository design and the reference disposal concept are applied, deterministic calculations with best estimate values as well as probabilistic calculations do not manifest unacceptable risk. Investigation of alternative concepts and design variants indicate a high potential for system optimization. (orig./HP).

**33760** (GSF–19/91) **Investigations on backfilling and sealing of chambers and shafts in a final salt repository. Final report.** Glaess, F. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung); Kappei, G.; Schmidt, M.W.; Schwieger, K.; Starke, C.; Taubert, E.; Wallmueller, R.; Walter, F.; Tischle, N.R.; Haensel, W.; Meyer,.GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Mar 1991. 270p. (In German). Contract EC FI-1W-0059-D(B). (GSF-TL–13/90). Order Number DE92714522. Source: OSTI; NTIS (US Sales Only); INIS.

Soil mechanical laboratory investigations as well as geotechnical in situ measurements were carried out. The laboratory tests provided important information on the material behaviour of selected backfill and sealing materials. Initial conclusions on the long-term behaviour of backfill and seals as well as on their interaction with the rock were gained with the results of in situ measurements in backfilled chambers and seals and in the surrounding rock of the Asse salt mine. (orig./DG).

**33761** (GSF–31/90) **Site surveys and safety investigations for the Asse salt mine including engineering developments. Final report.** Bode, W. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Braunschweig (Germany, F.R.). Inst. fuer Tieflagerung); Hensel, G.; Hente, B.; Herbert, H.J.; Reichelt, C.; Sander, W.; Starke, C.; Grisssemann, C. GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany). Jun 1990. 113p. (In German). Contract BMFT KWA 8502-7. (GSF-TL–35/90). Order Number DE92714357. Source: OSTI; NTIS (US Sales Only); INIS.

The objectives of the project were to obtain site data and safety propositions. The investigations concentrated, in particular, on the sorption properties of the cap rock for dissolved radionuclides, and on the movements of saline solutions from former potassium mines which several decades ago had been filled mainly with wet factory residues of the dressing process. Another aim was to obtain information about the in situ behaviour of drift sealing structures. Investigations were made to determine the gas and saline solution retention by drift sealings. In addition, measurements at an approximately 70 years old pack ridge were made as a basis for a proposition on long-term safety. (orig./HP).

**33762** (HW–20654-RD) **Rough draft - Lecture on decontamination.** Hall, J.W. Hanford Works, Richland, WA (United States). Mar 1949. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000329. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The subject of this document is decontamination and waste disposal. The selection of the best equipment design and the correct types of structural materials are discussed in relation to the extent of contamination. No excess equipment should be allowed near the scene of operations involving active materials. The control of activity levels in the laboratories in connection with good housekeeping and clean chemistry is emphasized.

**33763** (HW–55234-Del.) **Neptunium-237 in Hanford processes.** Brauer, F.P. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 6 Mar 1958. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018911. Source: OSTI; NTIS (US Sales Only); GPO Dep.

During 1956 a study of the path of neptunium in the Hanford processes and methods for recovery of the neptunium was initiated at Hanford. Based on discussions with persons familiar with the past and present plant operations, the path of neptunium through the various Hanford processes has been summarized. A list of reference containing more detailed information on the behavior of neptunium in Hanford and other processes is attached. 11 refs.

**33764** (JAERI-M–91-097) **The fundamental study for $Y_2O_3$ stabilized $ZrO_2$ containing simulated TRU.** Kuramoto, Ken-ichi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kamizono, Hiroshi; Hayakawa, Issei; Muraoka, Susumu; Yanagi, Tadashi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 39p. (In Japanese). Order Number DE92713915. Source: OSTI; NTIS (US Sales Only); INIS.

Borosilicate glass waste form is considered to be the most suitable material for the immobilization of high-level nuclear waste (HLW). However when the salt-free process on Purex method is adopted and the group partitioning technique of HLW is completely developed, ceramic waste forms which are excellent in thermal stability seem better for the immobilization of hazardous TRU elements. This work is a fundamental study on the solidification of TRU with $Y_2O_3$-stabilized $ZrO_2$. In this work, Ce and Nd were used as substitutes for Pu and Am or Cm. TZ-8Y (submicron powder) and designed $Ce(NO_3)_3$ or $Nd(NO_3)_3$ solution were mixed into paste. After dried, the paste was pelletized by the rubber press, and then sintered at 1400degC for 16h. Densities of the sintered pellets were measured and their microstructure was observed by X-ray diffraction and scanning electron microscopy. The results showed that (1) the relative density of ceramic pellet sample was as high as 96.4%, (2) each element was distributed homogeneously and only cubic phase existed. From leach tests in nitric acid and distilled water at 150degC, those ceramic pellet samples showed aqueous corrosion rates which were about $10^2$ to $10^3$ times lower than that of a glass waste form(PO500). (author).

**33765** (KFK–4833) **Report on research and development results in 1990 by the Institute for Nuclear Waste Management.**

Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Entsorgungstechnik. Mar 1991. 29p. (In German). Order Number DE92714352. Source: OSTI; NTIS (US Sales Only); INIS.

Report on research and development results in 1990 by the Institute for Nuclear Waste Management (INE). Priorities in 1990 were: Experiments on the behaviour of platinum metals during vitrification of high-level fission product solutions. Experiments at a technical plant and at a laboratory melter on the vitrification of simulated fission product solutions with a high content of platinum metals. Development of a closed treatment system for high and medium-level and alpha bearing wastes from reprocessing and mixed oxide fuel element fabrication. Solidification of the waste concentrate resulting from the above treatment, in an aluminium silicate matrix. Investigation into the actinide oxide/solidification matrix materials systems in contact with hydrochloric acid; determination of activity distribution between solid and liquid phases. Development of tests and models to register geochemical reactions between waste forms and saline solutions in the near vicinity of final repositories. Leaching experiments on spent LWR fuels in saline solutions. Investigations into the corrosion behaviour of material combinations for POLLUX containers designed for direct ultimate storage. Improvement of programmes to calculate the thermomechanical processes in the ultimate repository, and analyse the stress in drifts in the vicinity of the storage site. (orig./HP).

**33766** (K/TR–91/1) **Chemical decontamination of stainless steel.** Onuma, Tsutomu (Hitachi Plant Engineering Construction Co., Tokyo (Japan)); Akimoto, Hidetoshi. Oak Ridge K-25 Site, TN (United States). [1991]. 12p. Translation of Japanese Kokai Patent No. Hei 2[1990]-22596, January 25, 1990. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE91018441. Source: OSTI; NTIS; INIS; GPO Dep.

The present invention concerns a method for chemical decontamination of radioactive metal waste materials contaminated with radioactive materials on the surface, generated in radioactive materials-handling facilities. The invention is comprised of a method of chemical decontamination of stainless steel, characterized by comprising a first process of immersing a stainless steel-based metal waste material contaminated by radioactive materials on the surface in a sulfuric acid solution and second process of immersing in an aqueous solution of sulfuric acid and oxidizing metal salt, in which a portion of the surface of the stainless steel to be decontaminated is polished mechanically to expose a portion of the base material before the above first and second processes. 1 figs., 2 tabs.

**33767** (K/TR–91/3) **Decontamination apparatus for metals.** Enda, Masami (Toshiba Corp., Tokyo (Japan)); Fujita, Reiko. Oak Ridge K-25 Site, TN (United States). [1991]. 21p. Translation of Japanese Kokai Patent No. Hei 2[1990]-27298, January 30, 1990. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OT21400. Order Number DE91018440. Source: OSTI; NTIS; GPO Dep.

The present invention concerns a metal decontamination apparatus for decontamination of radioactive metal waste material from nuclear power facilities such as nuclear power plants, nuclear fuel reprocessing plants, etc., by electrochemical redox reaction. The invention is comprised of a metal decontamination apparatus, characterized by a metal decontamination apparatus using a decontamination solution containing trivalent cerium ion (Ce(3+)) and tetravalent cerium ion (Ce(4+)) to produce Ce(4+) from Ce(3+) by electrochemical redox reaction then using the oxidation power in converting Ce(4+) to Ce(3+) for dissolution and removal of the surface of the contaminated metal, wherein an ionic electrode apparatus selectively sensitive to Ce(3+) and Ce(4+) in the decontamination solution and a potentiometer are incorporated in the area in contact with the decontamination solution. 8 figs.

**33768** (LA-UR–91-2765) **A comparison of spent fuel assembly control instruments: The Cadarache PYTHON and the Los Alamos Fork.** Bignan, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Direction des Reacteurs Nucleaires); Capsie, J.; Romeyer-Dherbey, J.; Rinard, P. Los Alamos National Lab., NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9110195–2: American Nuclear Society (ANS) conference, Albuquerque, NM (United States). 4 Oct 1991). Order Number DE91018044. Source: OSTI; NTIS; INIS; GPO Dep.

Devices to monitor spent fuel assemblies while stored under water with nondestructive assay methods, have been developed in France and in the United States. Both devices are designed to verify operator's declared values of exposures and cooling-time but the applications and thus the designs of the systems differ. A study, whose results are presented in this paper, has been conducted to compare the features and the performances of the two instruments. 4 refs., 9 figs.

**33769** (LA-UR–91-3014) **Waste Management: An integrated modeling approach for analyzing change in NWC production processes.** Christensen, D.C. (Los Alamos National Lab., NM (United States)); Sohn, C.L.; Helm, T.M.; Farish, T.J.; Reid, R.A. Los Alamos National Lab., NM (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9110168–3: Department of Energy model conference, Oak Ridge, TN (United States), 14-17 Oct 1991). Order Number DE92000206. Source: OSTI; NTIS; INIS; GPO Dep.

A problem-driven, integrated modeling, decision-support framework has been conceptualized to aid a team of experts determine the set of evolving technologies that should receive additional developmental support. This conceptual framework utilizes a variety of decision aiding models including Flowsheeting, Analytical Hierarchy Process, Linear and Goal Programming, and Object-Oriented Discrete Event Simulation. A number of the technologies under consideration are strong candidates to overcome current plutonium processing problems so that effective technology will be available for implementation in Complex 21. Complex 21 is a participatory, inter-installation planning effort sponsored by US DOE to consolidate and revitalize the nuclear weapons complex facilities by the 21st century. A computer-based dynamic simulation model has been constructed that will allow testing of alternative combinations of developing technologies. The modeling of new configurations of technologies under a number of different operating conditions and material flow assumptions provides information needed for effective decision making for Complex 21. 4 figs.

**33770** (LBL–27767) **Prediction of release rates for a potential waste repository at Yucca Mountain.** Sadeghi, M.M.; Pigford, T.H.; Chambre, P.L.; Lee, W.W.L. Lawrence Berkeley Lab., CA (United States). Oct 1990. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000643. Source: OSTI; NTIS; INIS; GPO Dep.

Nuclear waste may be placed in the potential repository at Yucca Mountain in waste packages. The waste will consist of spent fuel assemblies or consolidated fuel rods, as well as borosilicate glass in steel pour containers, each enclosed in sealed containers. Current design calls for the waste packages to be surrounded by an air gap. Although the waste package is generally not seen as the primary barrier for nuclear waste isolation, it must in fact meet specific regulatory requirements. The US Nuclear Regulatory Commission requires that the release rate of any radionuclide from the engineered barrier system following the containment period shall not exceed one part in 100,000 per year of the inventory of that radionuclide calculated to be present at 1000 years following permanent closure. For low-inventory radionuclides, those that constitute less than 0.1 percent of the calculated total curie inventory at 1000 years, the allowable annual release is a constant value, equal to $10^{-8}$ of the total curie inventory in the repository at 1000 years. Therefore it is necessary to calculate release rates for waste packages at Yucca Mountain. We calculate release rates for key radionuclides using analytic solutions presented in a companion report. We consider both wet-drip and moist- continuous water-contact modes. We consider the release three types of species: solubility-limited species, species released congruent with solid-solid alteration of spent-fuel matrix or borosilicate glass, and readily soluble species from the fuel-cladding gap, gas plenum, and readily accessible grain boundaries. In each case we give the release rates of the species as a function of time. 22 refs., 11 figs., 9 tabs.

**33771** (PNL–7550) **The reactivity of cesium nickel ferrocyanide towards nitrate and nitrite salts: A status report.** Burger, L.L.; Scheele, R.D. Pacific Northwest Lab., Richland, WA

(United States). Sep 1991. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018293. Source: OSTI; NTIS; GPO Dep.

Beginning in late 1988, the Pacific Northwest Laboratory (PNL) began an experimental program at the request of Westinghouse Hanford Company (WHC) to investigate the effects of temperature on the oxidation reaction between synthetic nickel cesium ferrocyanide (FeCN) and nitrates and nitrites representative of materials present in some of the Hanford single-shell tanks (SSTs). After completing a preliminary series of experiments in 1988, the program was expanded to include five tasks to evaluate the effect of selected compositional and operational parameters on the reaction and explosion temperatures of FeCN and nitrate and/or nitrite mixtures. 10 refs., 4 figs., 6 tabs.

33772 (PNL–7718) **Archaeological mounds as analogs of engineered covers for waste disposal sites: Literature review and progress report.** Chatters, J.C.; Gard, H.A. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91019018. Source: OSTI; NTIS; GPO Dep.

Closure caps for low-level radioactive waste disposal facilities are typically designed as layered earthen structures, the composition of which is intended to prevent the infiltration of water and the intrusion of the public into waste forms. Federal regulations require that closure caps perform these functions well enough that minimum exposure guidelines will be met for at least 500 years. Short-term experimentation cannot mimic the conditions that will affect closure caps on the scale of centuries, and therefore cannot provide data on the performance of cap designs over long periods of time. Archaeological mounds hundreds to thousands of years old which are closely analogous to closure caps in form, construction details, and intent can be studied to obtain the necessary understanding of design performance. Pacific Northwest Laboratory conducted a review and analysis of archaeological literature on ancient human-made mounds to determine the quality and potential applicability of this information base to assessments of waste facility design performance. A bibliography of over 200 English-language references was assembled on mound structures from the Americas, Europe, and Asia. A sample of these texts was read for data on variables including environmental and geographic setting, condition, design features, construction. Detailed information was obtained on all variables except those relating to physical and hydrological characteristics of the mound matrix, which few texts presented. It is concluded that an extensive amount of literature and data are available on structures closely analogous to closure caps and that this information is a valuable source of data on the long-term performance of mounded structures. Additional study is recommended, including an expanded analysis of design features reported in the literature and field studies of the physical and hydraulic characteristics of different mound designs. 23 refs., 10 figs., 12 tabs.

33773 (PNL-SA–19908) **Potential for using a six-phase alternating current power supply system for in situ vitrification.** Richardson, R.L. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-910981–15: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE92000057. Source: OSTI; NTIS; INIS; GPO Dep.

In situ vitrification (ISV) has been identified as a potential treatment technology for stabilizing underground tanks at Hanford and other US Department of Energy (DOE) sites. A key requirement for this application is an electrical system that can supply the power needed to vitrify a tank in a single setting. This paper describes an engineering-scale test conducted at the Pacific Northwest Laboratory (PNL) to assess the efficiency of a six-electrode, six-phase energy supply system in melting soil. The test was conducted with a 30-kW six-phase system. Based on the test results, a six-electrode, six-phase system shows potential for scaleup to larger systems. 5 refs., 5 figs., 2 tabs.

33774 (RFP-Trans–502) **Process for decontamination of radioactively contaminated liquids.** Ganter, M. Rockwell International Corp., Golden, CO (United States). Rocky Flats Plant. Oct 1989. 4p. Translation of German Patent 3,644,396, 11 February 1988. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91018402. Source: OSTI; NTIS; INIS; GPO Dep.

In nuclear engineering plants there are produced radioactively contaminated lubricating oils, which heretofore have been disposed of by combustion and filtering of the radionuclides from the off-gas or by final storage. These prior art methods are cost-intensive. It is proposed to decontaminate radioactively contaminated lubricating oils by providing that an acid salt solution of the elements whose radionuclides are to be removed is added, the added acid salt solution is intimately mixed with the lubricating oil, the subsequently settling phase is drained off, an aqueous solution of a salt of a precipitating partner of the elements whose radionuclides are to be removed is added in metered manner with simultaneous intimate mixing, and the precipitation products are than removed from the lubricating oil by separation.

33775 (RFP-Trans–505) **Process for separation of radioactive constituents.** Gilak, A. Rockwell International Corp., Golden, CO (United States). Rocky Flats Plant. Nov 1989. 16p. Translation of German Patent Application No. 3,107,859 A1, October 21, 1982. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91018405. Source: OSTI; NTIS; INIS; GPO Dep.

Due to expanded employment of radioisotopes in industry and medicine, increasing amounts of radioactive solutions are being produced. By separating the isotopes from the process wastes, it is possible to minimize the contaminated material and store the concentrate until it is no longer hazardous. This is accomplished by mixing the solutions with either acids or bases, then distilling off the excess water. The radioactive substances remain in the concentrate and can either be removed from the apparatus or ashed for further volume reduction, with the gaseous effluents filtered to prevent release of radioisotopes. Distillation vapors are sucked into a separate tank for condensation, and another series of filters is placed between this tank and the vacuum pump to prevent contamination by non-condensing radioactive vapors. The distillate can be passed through an anion exchanger if contaminated or disposed of as nonradioactive liquid when appropriate. 2 figs (MHB)

33776 (Risley-Trans–6066) **The outline of the OMEGA project: Research and development of group partitioning and annihilation disposal of actinoids and fission products.** Umesawa, Hirokazu (Japan Atomic Energy Research Inst. (Japan)). AEA Technology, Risley (United Kingdom). 3 Jun 1991. 15p. Translated from Japanese. Order Number DE92601517. Source: OSTI; NTIS (US Sales Only); INIS.

Translated from Japanese.

This paper gives an account of the Japanese commitment to establish an environmentally friendly technology for the separation and utilization of radioactive stable nuclides in high-level radioactive wastes. The development of OMEGA (Options Making Extra Gains of Actinides and Fission Products) group partitioning/annihilation disposal is proposed to allow an effective utilisation of uranium resources. There will be information exchange with the OECD/NEA. (UK).

33777 (SAND–90-0707C) **Assessing the impact of waste-generated gas from the degradation of transuranic waste at the Waste Isolation Pilot Plant (WIPP): An overview of strongly coupled chemical, hydrologic, and structural processes.** Davies, P.B.; Brush, L.H.; Mendenhall, F.T. Sandia National Labs., Albuquerque, NM (United States). [1991]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109261–4: 3. OECD/NEA workshop: near-field effects of gas release, Aix-en-Provence (France), 23-26 Sep 1991). Order Number DE91018676. Source: OSTI; NTIS; INIS; GPO Dep.

The Waste Isolation Pilot Plant (WIPP) is a US Department of Energy repository for the permanent disposal of approximately 180,000 cubic meters of transuranic waste. The repository is located approximately 650 meters below land surface in a bedded salt formation. Microbial degradation of cellulosics in the waste and anoxic corrosion of steel containers and iron-bearing materials in the waste may generate significant quantities of gas. Experimental

and analytic studies are currently under way to evaluate the physical and chemical processes that control gas generation and repository response to gas pressurization. These studies indicate that the impact of waste-generated gas in the repository environment is likely to be characterized by strong coupling of chemical, hydrologic, and structural processes. For example, preliminary laboratory experiments suggest that gas generation rates depend on the availability of brine, which is controlled not only by hydrologic conditions surrounding the repository, but also by the rate at which gas pressure increases within the repository. Also, gas pressure in the repository is influenced by creep closure and consolidation of the room contents, which reduces the void volume available to store gas within a disposal room. However, the backstress of elevated gas pressure on the room walls may be capable of reversing room closure. Rigorous analysis of the coupled processes in the repository-rock system requires iterative development of experiments and models that characterize individual processes and system-scale models that characterize process coupling. Rigorous system-scale models are then used to test more streamlined performance assessment models that contain process and/or geometry simplifications in order to carry out probabilistic compliance calculations. 35 refs., 17 figs.

**33778** (SAND–90-1785) **In situ tests of salt deformation for validation of a radioactive waste repository predictive technology.** Munson, D.E. (Sandia National Labs., Albuquerque, NM (United States)). Sandia National Labs., Albuquerque, NM (United States); Sandia National Labs., Livermore, CA (United States). Jul 1991. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-910204–1: Society for Mining, Metallurgy and Exploration (SME) annual meeting and exhibit, Denver, CO (United States), 25-28 Feb 1991). Order Number DE91015645. Source: OSTI; NTIS; INIS; GPO Dep.

To assure the safety of a radioactive waste repository, it is necessary to predict the performance of the repository far into the future. The Waste Isolation Pilot Plant (WIPP) Program is responsible for developing the technology for such performance predictions in bedded salt. An important technology development activity concerns the fielding of very large scale in situ tests to determine the time-dependent deformation of underground openings salt as a basis for validation of the predictive technology. This technology is necessary to predict repository seal performance and final closure times of rooms, and may be of value to the salt and potash mining community, as well. 7 refs., 5 figs.

**33779** (SAND–90-2081) **Analysis of early creep closures in geomechanically connected underground rooms in salt.** Munson, D.E. (Sandia National Labs., Albuquerque, NM (United States)); Jones, R.L.; DeVries, K.L. Sandia National Labs., Albuquerque, NM (United States); Sandia National Labs., Livermore, CA (United States). Jul 1991. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-910728–5: 32. US symposium on rock mechanics, Norman, OK (United States), 10-12 Jul 1991). Order Number DE91016057. Source: OSTI; NTIS; GPO Dep.

The waste Isolation Pilot Plant (WIPP) Project is chartered to develop a technology base for the safe disposal of the radioactive Transuranic (TRU) waste forms generated by the US defense programs. The WIPP facility has been constructed in the bedded geologic salt deposits of southeastern New Mexico and is in preliminary operation in anticipation of receipt of small quantities of radioactive waste for experimental purposes. In accord with existing regulations, the requirement is to assure that any proposed repository isolates the radioactive waste from the accessible environment and mankind for a long period of time. As a part of this requirement, the creep closure of the salt and waste encapsulation must be predicted far into the future. This necessitates significant developments in the predictive technology of the structural response of underground excavations in salt. To provide a database for the validation of the predictive technology, a series of large scale in situ experiments were fielded at the WIPP under the auspices of the Thermal/Structural Interactions (TSI) Program. One of these experiments was a three room mine-by test. In this paper, we present the results of the early time (unheated) response of this test, showing the influence of adjacent excavations on each other and of multiple rooms on the closure rates. Also, the in situ results are compared with analyses making use of the most recent numerical predictive capability developed for describing the structural response of salt. 7 refs, 6 figs.

**33780** (SAND–90-2367) **The effect of brine on the creep of WIPP salt in laboratory tests.** Brodsky, N.S. (RE/SPEC, Inc., Rapid City, SD (United States)); Munson, D.E. Sandia National Labs., Albuquerque, NM (United States). Jul 1991. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-910728–6: 32. US symposium on rock mechanics, Norman, OK (United States), 10-12 Jul 1991). Order Number DE91015644. Source: OSTI; NTIS; INIS; GPO Dep.

WIPP salt specimens were tested under creep conditions using a constant stress difference of 15 MPa, a temperature of 20°C, and confining pressures between 0.5 MPa and 15 MPa. After 8 days of testing, saturated brine was introduced around each specimen so that the strain-rate response to the change in moisture content could be measured. Brine always caused immediate changes in axial, radial, and volumetric strain rates. Strain rates returned to their pre-brine-introduction values only for tests conducted with confining pressures greater than 3.5 MPa. These data indicate that permanent moisture effects do no occur when the confining pressure is sufficient to suppress specimen dilation (microfracturing). 3 refs., 10 figs., 1 tab.

**33781** (SAND–91-0025/1) **Exploratory Studies Facility alternatives study: Final report: Volume 1, Executive summary, supporting information, and study conclusions: Yucca Mountain Site Characterization Project.** Dennis, A.W. (ed.) (Sandia National Labs., Albuquerque, NM (United States)); Costin, L.S.; Finley, R.E.; Parsons, M.W. Sandia National Labs., Albuquerque, NM (United States). Sep 1991. 597p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91019015. Source: OSTI; NTIS; INIS; GPO Dep.

An Exploratory Studies Facility (ESF) is planned for use on the characterization of a potential site for a high-level nuclear waste repository at Yucca Mountain, NV. A comparative evaluation of ESF- repository design was conducted for the Department of Energy's Yucca Mountain Site Characterization Project Office. The purposed of the evaluation were to identify and rank order ESF-repository options and to improve understanding of the favorable or unfavorable features of an ESF design. The evaluation relied on techniques from decision analysis, including decision trees and multiattribute utility analysis (MUA). Decision trees provided a means for evaluating decisions under uncertainty. MUA provided a means for evaluating decisions with multiple, possibly competing objectives. Thirty-four ESF-repository options were evaluated and ranked based on inputs provided by 11 panels composed of technical specialists and one panel composed of senior managers. With guidance from decision analysts, the technical specialists developed the measures for quantifying performance; identified, developed, and analyzed scenarios for the development and operation of the ESF and the potential repository; and provided estimates of the probabilities of uncertainties and the performance of each option against various performance measures. With similar guidance, the senior managers specified the objectives and criteria for the evaluation, the value tradeoffs among objectives, and the attitude toward risk used in the analysis.

**33782** (SAND–91-0025/2) **Exploratory Studies Facility alternatives study: Final report: Volume 2, A comparative evaluation of alternative exploratory studies facility options: Yucca Mountain Site Characterization Project.** Dennis, A.W. (ed.) (Sandia National Labs., Albuquerque, NM (United States)); Merkhofer, M.W.; Beccue, P.; Gnirk, P.; Parrish, D.K.; Boyle, W.J. Sandia National Labs., Albuquerque, NM (United States). Sep 1991. 423p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91019016. Source: OSTI; NTIS; INIS; GPO Dep.

An Exploratory Studies Facility (ESF) is planned for use in the characterization of a potential site for a high-level nuclear waste repository at Yucca Mountain, NV. A comparative evaluation of ESF-repository design options was conducted for the Department of Energy's Yucca Mountain Site Characterization Project Office. The purposes of the evaluation were to identify and rank order

ESF-repository options and to improve understanding of the favorable or unfavorable features of an ESF design. The evaluation relied on techniques from decision analysis, including decision trees and multiattribute utility analysis (MUA). Decision trees provided a means for evaluating decisions under uncertainty. MUA provided a means for evaluating decisions with multiple, possibly competing objectives. Thirty-four ESF-repository options were evaluated and ranked based on inputs provided by 11 panels composed of technical specialists and one panel composed of senior managers. With guidance from decision analysts, the technical specialists developed the measures for quantifying performance; identified, developed, and analyzed scenarios for the development and operation of the ESF and the potential repository; and provided estimates of the probabilities of uncertainties and the performance of each option against various performance measures. With similar guidance, the senior managers specified the objectives and criteria for the evaluation, the value tradeoffs among objectives, and the attitude toward risk used in the analysis.

**33783** (SAND–91-0105) **Interim report on the effects of brine-saturation and shear stress on consolidation of crushed, natural rock salt from the Waste Isolation Pilot Plant (WIPP).** Zeuch, D.H.; Zimmerer, D.J.; Shields, M.E.F. Sandia National Labs., Albuquerque, NM (United States). Jul 1991. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91018624. Source: OSTI; NTIS; INIS; GPO Dep.

The mechanical behavior of crushed natural rock salt is of concern to the Waste Isolation Pilot Plant (WIPP) Project because excavated salt is a candidate material for use as backfill around the waste packages and in storage rooms, shafts and other underground openings. To complement existing studies on the compaction behavior of dry and damp (i.e., unsaturated) crushed rock salt under hydrostatic compression, we initiated an extensive experimental program to evaluate (1) the effect of brine-saturation on the consolidation rates and terminal densities of crushed salt subjected to hydrostatic compression, and (2) the influence of small deviatoric stresses on the consolidation rate damp crushed rock salt. This investigation is incomplete, and laboratory facilities are limited, therefore, in this report we review available results, in order to make available preliminary estimates of the effects of brine-saturation and shear stress on consolidation. Experiments with brine were carried out under nominally drained conditions. Experiments completed to data include five hydrostatic compaction tests on brine-saturated samples, run at pressures ranging from 1.72 to 10.34 MPa, and two prototype shear consolidation experiments run at a mean stress of 3.45 MPa and a stress difference of 0.69 MPa. Both sets of experiments were run at 20±0.5 °C. Although the experiments on brine-saturated crushed rock salt exhibit several discrepancies, we can draw the following conclusions. (1) Though effects associated with brine-saturated apparently have a retarding effect on consolidation, rates are reduced by less than an order of magnitude when compared with unsaturated specimens. Despite saturation, high fractional densities (>0.95) are attainable even on laboratory time scales using pressures well below lithostatic at the WIPP (≈ 15 MPa). 23 refs., 26 figs., 5 tabs.

**33784** (SAND–91-0913C) **Need to use probabilistic risk approach in performance assessment of waste disposal facilities.** Bonano, E.J.; Gallegos, D.P. Sandia National Labs., Albuquerque, NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9110168–2: Department of Energy model conference, Oak Ridge, TN (United States), 14-17 Oct 1991). Order Number DE92000234. Source: OSTI; NTIS; INIS; GPO Dep.

Regulations governing the disposal of radioactive, hazardous, and/or mixed wastes will likely require, either directly or indirectly, that the performance of disposal facilities be assessed quantitatively. Such analyses, commonly called "performance assessments," rely on the use of predictive models to arrive at a quantitative estimate of the potential impact of disposal on the environment and the safety and health of the public. It has been recognized that a suite of uncertainties affect the results of a performance assessment. These uncertainties are conventionally categorized as (1) uncertainty in the future state of the disposal system (facility and surrounding medium), (2) uncertainty in models (including conceptual models, mathematical models, and computer codes), and (3) uncertainty in data and parameters. Decisions regarding the suitability of a waste disposal facility must be made in light of these uncertainties. Hence, an approach is needed that would allow the explicit consideration of these uncertainties so that their impact on the estimated consequences of disposal can be evaluated. While most regulations for waste disposal do not prescribe the consideration of uncertainties, it is proposed that, even in such cases, a meaningful decision regarding the suitability of a waste disposal facility cannot be made without considering the impact of the attendant uncertainties. A probabilistic risk assessment (PRA) approach provides the formalism for considering the uncertainties and the technical basis that the decision makers can use in discharging their duties. A PRA methodology developed and demonstrated for the disposal of high-level radioactive waste provides a general framework for assessing the disposal of all types of wastes (radioactive, hazardous, and mixed). 15 refs., 1 fig., 1 tab.

**33785** (SAND–91-1021C) **Continued development of hybrid directional boring technology and New horizontal logging development for characterization, monitoring and instrument emplacement at environmental sites.** Wemple, R.P. (Sandia National Labs., Albuquerque, NM (United States)); Meyer, R.D.; Jacobson, R.D.; Layne, R.R. Sandia National Labs., Albuquerque, NM (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9110168–1: Department of Energy model conference, Oak Ridge, TN (United States), 14-17 Oct 1991). Order Number DE91018673. Source: OSTI; NTIS; GPO Dep.

This work in partnership with industry is a continuation of cost-effective innovative, directional boring development begun in FY90 and planed to extend into FY94. Several demonstrations of the strategy of building hybrid hardware from utilities installation, geothermal, and soil mechanics technologies have been performed at Sandia National Laboratories (SNL) and at Charles Machine works (CMW) test sites as well as at a commercial refinery site. Additional tests at the SNL Directional Boring Test Range (DBTR) and a lagoon site are planned in calendar 1991. A new companion project to develop and demonstrate a hybrid capability for horizontal logging with penetrometers, specialty instruments and samplers has been taken from concept to early prototype hardware. The project goal of extending the tracking/locating capability of the shallow boring equipment to 80in. is being pursued with encouraging results at 40in. depths. Boring costs, not including tailored well completions dictated by individual site parameters, are estimated at $20 to $50 per foot. Applications continue to emerge for this work and interest continues to be expressed by DoD and EPA researchers and environmental site engineers. 12 figs.

**33786** (SAND–91-1738C) **Origin and composition of possible fluids in German and American high- and intermediate-level radioactive waste repositories in domal and bedded salt formations.** Herbert, H.J. (Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Braunschweig (Germany). Inst. fuer Tieflagerung); Brush, L.H.; Rutherford, B.M. Sandia National Labs., Albuquerque, NM (United States). [1991]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109268–1: OECD/NEA workshop on long-term observation of the geological environment: needs and techniques, Helsinki (Finland), 9-11 Sep 1991). Order Number DE91019067. Source: OSTI; NTIS; INIS; GPO Dep.

This paper justifies the need for and describes studies of brine chemistry under way for German and American high- and intermediate-level radioactive waste repositories in domal and bedded salt formation. In particular, it discusses the origin and composition of fluids that could enter these repositories and some sampling, modeling, and statistical techniques used to characterize them. 24 refs., 4 figs., 5 tabs.

**33787** (SAND–91-1872C) **Sensitivity studies for gas release from the Waste Isolation Pilot Plant (WIPP).** Webb, S.W. Sandia National Labs., Albuquerque, NM (United States). [1991]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109261–2: 3. OECD/NEA workshop: near-field effects of gas release, Aix-en-Provence

(France), 23-26 Sep 1991). Order Number DE91018810. Source: OSTI; NTIS; INIS; GPO Dep.

Sensitivity studies have been conducted for the gas release from the Waste Isolation Pilot Plant (WIPP) using the TOUGH2 computer code with performance measures of peak repository pressure and gas migration distance at 1000 years. The effect of formation permeabilities including impermeable halite, two-phase characteristic curves including different models and residual saturations, and other variations was studied to determine their impact on the performance of the WIPP repository. 15 refs., 7 figs., 2 tabs.

**33788** (SAND–91-7030C) **Thermally driven gas flow beneath Yucca Mountain, Nevada.** Amter, S. (Disposal Safety, Inc., Washington, DC (United States)); Lu, Ning; Ross, B. Sandia National Labs., Albuquerque, NM (United States). 26 Jul 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911213–11-Draft: American Society of Mechanical Engineers (ASME) annual winter meeting, Atlanta, GA (United States), 1-6 Dec 1991). Order Number DE92000792. Source: OSTI; NTIS; INIS; GPO Dep.

A coupled thermopneumatic model is developed for simulating heat transfer, rock-gas flow and carbon-14 travel time beneath Yucca Mountain, NV. The aim of this work is to understand the coupling of heat transfer and gas flow. Heat transfer in and near the potential repository region depends on several factors, including the geothermal gradient, climate, and local sources of heat such as radioactive wastes. Our numerical study shows that small temperature changes at the surface can change both the temperature field and the gas flow pattern beneath Yucca Mountain. A lateral temperature difference of 1 K is sufficient to create convection cells hundreds of meters in size. Differences in relative humidities between gas inside the mountain and air outside the mountain also significantly affect the gas flow field. 6 refs., 7 figs.

**33789** (UCRL-ID–105163) **Air-injection field tests to determine the effect of a heat cycle on the permeability of welded tuff.** Lee, K.H.; Ueng, Tzou-Shin. Lawrence Livermore National Lab., CA (United States). [1991]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000098. Source: OSTI; NTIS; INIS; GPO Dep.

As part of a series of prototype tests conducted in preparation for site characterization of the potential nuclear-waste repository site at Yucca Mountain, Nevada, air-injection tests were conducted in the welded tuffs in G-Tunnel at the Nevada Test Site. The objectives were to characterize the permeability of the highly fractured tuff around a horizontal heater emplacement borehole, and to determine the effect of a heating and cooling cycle on the rock-mass permeability. Air was injected into packed-off intervals along the heater borehole. The bulk permeability of the rock adjacent to the test interval and the aperture of fractures intersecting the interval were computed from the air-flow rate, temperature, and pressure at steady state. The bulk permeability of intervals along with borehole varied from a minimum of 0.08 D to a maximum of over 144 D and the equivalent parallel-plate apertures of fractures intersecting the borehole varied from 70 to 589 $\mu$m. Higher permeabilities seemed to correlate spatially with the mapped fractures. The rock was then heated for a period of 6.5 months with an electrical-resistive heater installed in the borehole. After heating, the rock was allowed to cool down to the ambient temperature. The highest borehole wall temperature measured was 242°C. Air injection tests were repeated following the heating and cooling cycle, and the results showed significant increases in bulk permeability ranging from 10 to 1830% along the borehole. 8 ref., 6 figs., 3 tabs.

**33790** (UCRL-ID–106159) **Prototype Engineered Barrier System Field Test (PEBSFT): Final report.** Ramirez, A.L. (ed.); Buscheck, T.; Carlson, R.; Daily, W.; Lee, K.; Lin, Wunan; Mao, Nai-hsien; Ueng, Tzou-Shin; Wang, H.; Watwood, D. Lawrence Livermore National Lab., CA (United States). Aug 1991. 104p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000102. Source: OSTI; NTIS; INIS; GPO Dep.

This final report represents a summary of data and interpretations obtained from the Prototype Engineered Barrier System Field Test (PEBSFT) performed in G-Tunnel within the Nevada Test Site. The PEBSFT was conducted to evaluate the applicability of measurement techniques, numerical models, and procedures developed for future field tests that will be conducted in the Exploratory Studies Facilities (ESF) at Yucca Mountain. The primary objective of the test was to provide a basis for determining whether tests planned for the ESF have the potential to be successful. Chapter 1 on high frequency electromagnetic tomography discusses the rock mass electromagnetic permittivity and attenuation rate changes that were measured to characterize the water distribution in the near field of a simulated waste container. The data are used to obtain quantitative estimates of how the moisture content in the rock mass changes during heating and to infer properties of the spatial variability of water distribution, leading to conclusions about the role of fractures in the system. Chapter 2 discusses the changes in rock moisture content detected by the neutron logging probe. Chapter 3 permeability tests discusses the characterization of the in-situ permeability of the fractured tuff around the borehole. The air permeability testing apparatus, the testing procedures, and the data analysis are presented. Chapter 4 describes the moisture collection system installed in the heater borehole to trap and measure the moisture volumes. Chapter 5 describes relative humidity measurements made with the thermocouple psychrometer and capacitance sensors. Chapter 6 discusses gas pressure measurements in the G-Tunnel, addressing the calibration and installation of piezoresistive-gaged transducers. Chapter 7 describes the calibration and installation of thermocouples for temperature measurements. Chapter 8 discusses the results of the PEBSFT.

**33791** (UCRL-JC–105665) **Modeling of a dissolution system for transuranic compounds.** Chiba, Z.; Dease, C. Lawrence Livermore National Lab., CA (United States). Feb 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-910852–15: Summer national meeting of the American Institute of Chemical Engineers (AIChE), Pittsburgh, PA (United States), 20-22 Aug 1991). Order Number DE91018998. Source: OSTI; NTIS; INIS; GPO Dep.

A system is currently being developed at Lawrence Livermore Laboratory to treat transuranic wastes by means of a mediated electrochemical oxidation process. The process involves generating $Ag^{(++)}$ from a solution of silver nitrate and nitric acid in an electrochemical cell. $Ag^{(++)}$ is highly reactive and is capable of attacking many organic and inorganic substances. In particular, if a mixture of particles containing transuranic and other scrap metal oxides is allowed to react with $Ag^{(++)}$ in a nitric acid solution, the transuranic oxides will dissolve and can be removed with the solution leaving the other insoluble oxides behind. The dissolution of the transuranic oxides by reactions with $Ag^{(++)}$ occurs due to further oxidation to higher valence states and the formation of soluble ions such as $MO_2^{+}$ and $MO_2^{++}$. 7 refs., 5 figs., 1 tab.

**33792** (WHC-EP–0182-36) **Tank farm surveillance and waste status report for March 1991.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (United States). Jun 1991. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE91018143. Source: OSTI; NTIS; INIS; GPO Dep.

This report is Westinghouse Hanford Company's official inventory for radioactive waste stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. The intent of the report is to provide data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and special surveillance facilities, and to provide supplemental information regarding tank surveillance anomalies and ongoing investigations. 2 figs., 8 tabs.

**33793** (WHC-EP–0182-37) **Tank farm surveillance and waste status report for April 1991.** Hanlon, B.M. Westinghouse Hanford Co., Richland, WA (United States). Jul 1991. 88p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE91018138. Source: OSTI; NTIS; INIS; GPO Dep.

This report is Westinghouse Hanford Company's official inventory for radioactive stored in underground tanks in the 200 Areas at the Hanford Site. Data that depict the status of stored radioactive waste and tank vessel integrity are contained within the report. The

intent of the report is to provide data on each of the existing 177 large underground waste storage tanks and 49 smaller catch tanks and special surveillance facilities, and to provide supplemental information regarding tank surveillance anomalies and ongoing investigations. 2 figs., 8 tabs.

33794 (WHC-EP–0363-Rev.1) **Solid Waste Program Plan: Revision 1.** Duncan, D.R. Westinghouse Hanford Co., Richland, WA (United States). Aug 1991. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000528. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of the Solid Waste Program Plan (SWPP) is to provide a summary level comprehensive approach for the storage, treatment, and disposal of current and future solid waste received at the Hanford Site (from onsite and offsite generators) in a manner compliant with current and evolving applicable regulations and orders [federal, state, local, and Westinghouse Hanford Company (Westinghouse Hanford)]. A previous version of the SWPP (entitled Solid Waste Management Program Plan) was drafted in 1990 and released as WHC-EP-0363 (WHC 1990c). The SWPP also presents activities required for disposal of selected wastes currently in retrievable storage. The SWPP provides a central focus for the description and control of cost, scope, and schedule of Hanford Site solid waste activities and provides a vehicle for ready communication of the scope of these activities to onsite and offsite organizations. This SWPP represents the most complete description available of Hanford Site solid waste activities and the interfaces between those activities. It will be updated annually to reflect changes in plans due to evolving regulatory requirements and/or the solid waste mission. 26 refs., 11 figs., 1 tabs.

33795 (WHC-EP–0392) **Tank Farm Upgrades Program Plan.** Henderson, J.M. Westinghouse Hanford Co., Richland, WA (United States). Jun 1991. 244p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE91018146. Source: OSTI; NTIS; INIS; GPO Dep.

The Tank Farm Upgrades Program Plan provides a summary description of work plans for the W1R End Function, Tank Farms Upgrade Program. This program was established to renovate the Tank Farm infrastructure with upgrades in equipment, systems, and facilities. The program also includes development of a configuration control database consisting of as-built drawings and a uniform equipment tag number and labeling system. The final segment of the upgrade program is a contamination zone reduction program to prevent the spread of surface contamination within the Tank Farms. These upgrades are based on current requirements from US Department of Energy (DOE) Orders, Washington State regulations, and the result of finding and observations from recent audits and surveillances of Tank Farm facilities and operations. Additional items were identified based on the results of a self-assessment of Tank Farm upgrades necessary to accomplish the Tank Farm mission. This plan will serve as the technical basis for the annual budget submittal for the new Tank Farms End Function W1R, Tank Farm Upgrades Plan. 94 refs., 20 figs., 7 tabs.

33796 (WSRC-tr–142) **Aqueous corrosion of borosilicate glasses nature and properties of alteration layers.** Trotignon, L. (Laboratory of Long-Term Behavior Research, Fontenay aux Roses Cedex (France)). Westinghouse Savannah River Co., Aiken, SC (United States). [1991]. 188p. Translation of French thesis presented before Paul Sabatier University in Toulouse, June 25, 1990. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC09-89SR18035. Order Number DE91017642. Source: OSTI; NTIS; INIS; GPO Dep.

In this study, we compare corrosion and alteration layers of gradually more complex borosilicate glasses, from a ternary sodium borosilicate glass to a simulated nuclear glass (this concerns the standard French glass SON 68 18 17 L1 C2 A2 Z1, also called R7T7, whose exact composition is given in Nogues [1984]). The simplified glasses, called G2, G3, etc., are formulated to respect the same molar ratios between the different oxides composing them as those of simulated nuclear glass. We progressively increase their complexity by adding the oxides in nuclear glass to them by decreasing order of abundance. After some theoretical comments on the structure and corrosion of borosilicate glasses, we present the material studied, the aqueous corrosion experiments, and the analytical techniques used for studying the alteration layers. We present the experimental results. We study the mechanism of formation of altered layers by analysis of lixivia. This study uses corrosion experiments conducted at 90°C on all of the glasses. For the glasses in the series least resistant to corrosion (G2, G3, G4, G5), analyses of the lixivia obtained in the corrosion experiments at 65°C complete the data obtained at 90°C and permit better understanding the genesis of the hydrated layers. We also report the geochemical modeling conducted from the analysis of the attack solutions in this part. We discuss the implications for underground storage of nuclear glasses from our results at this time, we give some prospects for further research in this area.

## 0530 Environmental Aspects

*Refer also to citation(s) 33736, 33803, 33804, 33809, 34055, 35056, 35057, 35063, 35065, 35074, 35075, 35081*

33797 (ORNL/ER–52) **Surface radiological investigations at White Wing Scrap Yard, Oak Ridge Reservation, Oak Ridge, Tennessee.** Williams, J.K.; Rodriguez, R.E.; Uziel, M.S.; Tiner, P.F. Oak Ridge National Lab., TN (United States). Sep 1991. 62p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91018993. Source: OSTI; NTIS; GPO Dep.

A surface radiological scoping survey of accessible areas at the White Wing Scrap Yard [Waste Area Grouping 11 (WAG 11)] was conducted intermittently from December 1989 through July 1991 by members of the Measurement Applications and Development Group, Health and Safety Research Division, Oak Ridge National Laboratory (ORNL) at the request of Environmental Restoration Program personnel at ORNL. The White Wing Scrap Yard is an estimated 30-acre, predominately wooded area located on the western edge of East Fork Ridge in the McNew Hollow area on the US Department of Energy's Oak Ridge Reservation. The scrap yard was formerly used for aboveground storage of contaminated material (e.g., steel tanks, metal, glass, concrete, and miscellaneous industrial trash) from the Oak Ridge K-25 Site, Oak Ridge Y-12 Plant, and ORNL. The purposes of this cursory investigation were (1) to provide an updated contamination status of the site by locating and interpreting the presence, nature, and extent of surface radiological contamination and (2) to provide a basis for the formulation of interim corrective action to limit human exposures to radioactivity and minimize the potential for contaminant dispersion. 13 refs., 17 figs., 5 tabs.

33798 (WHC-EP–0445) **PORMC: A model for Monte Carlo simulation of fluid flow, heat, and mass transport in variably saturated geologic media.** Westinghouse Hanford Co., Richland, WA (United States). Sep 1991. 318p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000233. Source: OSTI; NTIS; INIS; GPO Dep.

This computer program was developed in support of environmental restoration activities being conducted at the Hanford Site to comply with the Resource Conservation and Recovery Act of 1976 and its 1984 amendum; the Comprehensive Environmental Response, Compensation, and Liability Act as amended in 1986; and the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1990). The results of analyses made using the computer program will be used in remedial investigations to study the possible nature and extent of contamination and in feasibility studies to analyze the environmental consequences associated with alternative remediation methods. This document provides details of the theory and instructions for use of the PORMC computer program. 80 refs.

## 0540 Health and Safety

*Refer also to citation(s) 33797, 33812, 34131, 34161, 34780, 35083*

33799 (ANL/CP–74208) **Release criteria and pathway analysis for radiological remediation.** Subbaraman, G. (Rockwell International Corp., Canoga Park, CA (United States). Rocketdyne Div.); Tuttle, R.J.; Oliver, B.M.; Devgun, J.S. Argonne National

Lab., IL (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910981–21: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE92000364. Source: OSTI; NTIS; INIS; GPO Dep.

Site-specific activity concentrations were derived for soils contaminated with mixed fission products (MFP), or uranium-processing residues, using the Department of Energy (DOE) pathway analysis computer code RESRAD at four different sites. The concentrations and other radiological parameters, such as limits on background-subtracted gamma exposure rate were used as the basis to arrive at release criteria for two of the sites. Valid statistical parameters, calculated for the distribution of radiological data obtained from site surveys, were then compared with the criteria to determine releasability or need for further decontamination. For the other two sites, RESRAD has been used as a preremediation planning tool to derive residual material guidelines for uranium. 11 refs., 4 figs., 3 tabs.

**33800** (CONF-9104135– II.A.1.1-II.A.1.6) **DOE technical staff training program.** Birk, S.M. (EG and G Idaho Inc., Idaho Falls (USA)). Oak Ridge National Lab., TN (United States). Apr 1991. From 9. symposium on the training of nuclear facility personnel; Denver, CO (United States); 14-18 Apr 1991. In *Proceedings of the ninth symposium on the training of nuclear facility personel.* 623p. Order Number DE91010496. Source: OSTI; NTIS; INIS.

This paper summarizes the Department of Energy's current approach to the accreditation of technical staff training programs. It includes the basis for inclusion of the program, a description of attempts to address applicability and content size for the program, a summary of current activities, and a description of the role of the Department of Energy accreditation program administrator.

**33801** (CONF-9104135– V.A.5.1-V.A.5.6) **Remote mechanical C line.** Nuttall, K.R. (Westinghouse Hanford Co., Richland, WA (USA)); Gardner, P.R. Oak Ridge National Lab., TN (United States). Apr 1991. From 9. symposium on the training of nuclear facility personnel; Denver, CO (United States); 14-18 Apr 1991. In *Proceedings of the ninth symposium on the training of nuc—ear facility personel.* 623p. Order Number DE91010496. Source: OSTI; NTIS; INIS.

Westinghouse Hanford Company is developing a desk-top simulation based training program on the operation of the Remote Mechanical C (RMC) Line process in the Plutonium Finishing Plant on the Hanford site, Richland, Washington. Simulations display aod contiously update current values of system parameters on computer graphics of RMC line equipment. Students are able to operate a variety of controllers to maintain proper system status. Programmed faults, selectable by the course instructor, can be used to test student responses to off-normal events. Prior to operation of the simulation, students are given computer-based tutorials on the function, processes, operation, and error conditions associated with individual components. By including the capability of operating each individual component - valves, heaters, agitators, etc. - the computer-based training (CBT) lessons become an interactive training manual. From one perspective RMC represents one step in the diffusion of the well-known and well-documented simulator training activities for nuclear reactor operators to other training programs, equally critical, perhaps, but less well scrutinized in the past. Because of the slowly responding nature of the actual process, RMC can retain many of the capabilities of practice and testing in a simulated work environment while avoiding the cost of a full scale simulator and the exposure and waste developed by practice runs of the RMC line. From another perspective RMC suggests training advances even beyond the most faithful simulators. For example, by integrating CBT lessons with the simulation, RMC permits students to focus in on specific processes occurring inside chosen components. In effect, the interactive training manual is available on-line with the simulation itself. Cost are also discussed.

**33802** (DOE/EH–0207P) **Environmental Audit of the Grand Junction Projects Office.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Environmental Audit. Aug 1991. 300p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000523. Source: OSTI; NTIS; INIS; GPO Dep.

The Grand Junction Projects Office (GJPO) is located in Mesa County, Colorado, immediately south and west of the Grand Junction city limits. The US Atomic Energy Commission (AEC) established the Colorado Raw Materials Office at the present-day Grand Junction Projects Office in 1947, to aid in the development of a viable domestic uranium industry. Activities at the site included sampling uranium concentrate; pilot-plant milling research, including testing and processing of uranium ores; and operation of a uranium mill pilot plant from 1954 to 1958. The last shipment of uranium concentrate was sent from GJPO in January, 1975. Since that time the site has been utilized to support various DOE programs, such as the former National Uranium Resource Evaluation (NURE) Program, the Uranium Mill Tailings Remedial Action Project (UMTRAP), the Surplus Facilities Management Program (SFMP), and the Technical Measurements Center (TMC). All known contamination at GJPO is believed to be the result of the past uranium milling, analyses, and storage activities. Hazards associated with the wastes impounded at GJPO include surface and ground-water contamination and potential radon and gamma-radiation exposure. This report documents the results of the Baseline Environmental Audit conducted at Grand Junction Projects Office (GJPO) located in Grand Junction, Colorado. The Grand Junction Baseline Environmental Audit was conducted from May 28 to June 12, 1991, by the Office of Environmental Audit (EH-24). This Audit evaluated environmental programs and activities at GJPO, as well as GJPO activities at the State-Owned Temporary Repository. 4 figs., 12 tabs.

**33803** (DOE/OR/21949–288) **St. Louis airport site annual environmental report for calendar year 1990, St. Louis, Missouri: Formerly Utilized Sites Remedial Action Program (FUSRAP).** Bechtel National, Inc., Oak Ridge, TN (United States). Aug 1991. 149p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-91OR21949. Order Number DE91017593. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental monitoring of the US Department of Energy's (DOE) St. Louis Airport Site (SLAPS) and surrounding area began in 1984. SLAPS is part of the Formerly Utilized Sites Remedial Action Program (FUSRAP), a DOE program to decontaminate or otherwise control sites where residual radioactive materials remain from the early years of the nation's atomic energy program or from commercial operations causing conditions that Congress has authorized DOE to remedy. Monitoring results are compared with applicable Environmental Protection Agency (EPA) standards; federal, state, and local applicable or relevant and appropriate requirements (ARARs); and/or DOE derived concentration guidelines (DCGs). Environmental standards, ARARs, and DCGs are established to protect public health and the environment. Results from the 1990 environmental monitoring program demonstrated that the concentrations of contaminants of concern were all below applicable standards, ARARs, and guidelines. Site activities in 1990 were limited to maintenance. SLAPS was in compliance with all applicable regulations during 1990 and has remained in compliance since 1984, when the environmental monitoring program and remedial action began.

**33804** (DOE/RL–91-30) **Hanford Federal Facility Agreement and Consent Order quarterly progress report for the period ending June 30, 1991.** USDOE Richland Operations Office, WA (United States). Aug 1991. 84p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000889. Source: OSTI; NTIS; GPO Dep.

This is the ninth quarterly report as required by the Hanford Federal Facility Agreement and Consent Order (Ecology et al. 1990), also known as the Tri-Party Agreement, established between the US Department of Energy (DOE), the US Environmental Protection Agency (EPA), and the Washington State Department of Ecology (Ecology). The Tri-Party Agreement sets the plan and schedule for achieving regulatory compliance and cleanup of waste sites at the Hanford Site. This report covers progress for the quarter that ended June 30, 1991. A total of 87 milestones have been completed to date. 39 refs., 1 fig.

**33805** (EGG-WM–9732) **Health and Safety Plan for operations performed for the Environmental Restoration Program: Task: Vapor vacuum extraction.** Lugar, R.M. EG and G Idaho,

Inc., Idaho Falls, ID (United States). Jul 1991. 130p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018758. Source: OSTI; NTIS; INIS; GPO Dep.

This document constitutes the generic health and safety plan for the Environmental Restoration Program (ERP). It addresses the health and safety requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120 standard; and EG&G Idaho, Inc. This plan is a guide to individuals who must complete a health and safety plan for a task performed for the ERP. It contains a task specific addendum that, when completed, specifically addresses task specific health and safety issues. This health and safety plan reduces the time it takes to write a task specific health and safety plan by providing discussions of requirements, guidance on where specific information is located, and specific topics in the Addendum that must be discussed at a task level. This format encourages a complete task specific health and safety plan and a standard for all health and safety plans written for ERP. This plan also incorporates the "Health and Safety Plan for Operations Performed for the Environmental Restoration Program" (EGG-WM-8771, Rev. 1) with an addendum completed for vapor vacuum extraction (VVE). The VVE project includes sampling and analysis of gas concentrations in monitors and open wells, measurement of pressures in monitoring wells, measurement of extraction well gas and system operational parameters in support of characterizing the volatile organic compounds (VOC) contamination beneath the subsurface disposal area (SDA) of the Radioactive Waste Management Complex (RWMC), calibrating the organic transport model and prevailing engineering data for a final remedial action. 16 refs., 10 figs., 4 tabs.

**33806** (FMPC–2222) **Program management strategies for following EPA guidance for remedial design/remedial action at DOE sites.** Hopper, J.P. (Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project); Chew, J.R.; Kowalski, T.E. Westinghouse Environmental Management Co. of Ohio, Cincinnati, OH (United States). Fernald Environmental Management Project. [1991]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-86OR21600. (CONF-910981–7: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE91018559. Source: OSTI; NTIS; GPO Dep.

At the US Department of Energy (DOE) facilities, environmental restoration is being conducted in accordance with Federal Facilities Compliance Agreements (or Interagency Agreements). These agreements establish a cooperative working relationship and often define roles, responsibilities and authorities for conduct and oversight of the Remedial Action Programs. The US Environmental Protection Agency (EPA) has guidelines on how to initiate and perform remedial actions for sites they are remediating under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Re-Authorization Act (SARA). This paper addresses some of the difference and commonalities between the DOE project management procedures and EPA guidance documents. This report covers only the RD/RA phase of environmental restoration. 10 figs.

**33807** (HW–60699) **Estimate of gamma dose rates from 1000 MWD/T and 2000 MWD/T plutonium.** Brown, C.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Jun 1959. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000350. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A radiation study was made in the 234-5 Building in May 1959, in which defined, in general, the energy spectrum of the gamma radiation emitted by the plutonium processing hoods on the RMA Line and in Recuplex. This study also helped to more accurately define the relative effectiveness of $\frac{1}{4}$ in. and 1 in. lead glass in reducing these various gamma fields with their characteristic energy spectrums. This information, in addition to information obtained in the laboratory in 1958, gave a fairly accurate picture of the gamma field in the 234-5 Building when processing 525–650 MWD/T plutonium. The purpose of this report is to estimate how much the gamma radiation fields and dose rates will increase when the plutonium being processed is of the 1000 MWD/T or 2000 MWD/T variety; also, to estimate how much this increase can be compensated by shielding the processing equipment with $\frac{1}{4}$ in. or 1 in. lead glass (or equivalent). 4 refs., 3 tabs.

**33808** (NUREG–1272-Vol.5-No.2) **Office for Analysis and Evaluation of Operational Data: 1990 annual report, nonreactors: Volume 5, No. 2.** Nuclear Regulatory Commission, Washington, DC (United States). Office for Analysis and Evaluation of Operational Data. Jul 1991. 75p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

The annual report of the US Nuclear Regulatory Commission's Office for Analysis and Evaluation of Operational Data (AEOD) is devoted to the activities performed during 1990. This document, NUREG-1272, Vol. 5, No. 2, covers nonreactors and presents a review of the events and concerns during 1990 associated with the use of licensed material in nonreactor applications, such as personnel overexposures and medical misadministrations. The reports contain a discussion of the Incident Investigation Team program and summarize both the Incident Investigation Team and Augmented Inspection Team reports for that group of licensees. Each volume contains a list of the AEOD reports issued for 1981 through 1990.

**33809** (PNL–7785) **1991 Yearly calibration of Pacific Northwest Laboratory's gross gamma-ray borehole geophysical logging system.** Arthur, R.J. Pacific Northwest Lab., Richland, WA (United States). Aug 1991. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000391. Source: OSTI; NTIS; GPO Dep.

This report describes the 1991 yearly calibration of a gross gamma-ray geophysical pulse logging system owned by the US Department of Energy (DOE) and operated by the Pacific Northwest Laboratory. The calibration was conducted to permit the continued use of this system for geologic and hydrologic studies associated with remedial investigations at the Hanford Site. Primary calibrations to equivalent uranium units were conducted in DOE borehole model standards that reside on the Hanford Site. The calibrations were performed in borehole models SBL/SBH and SBA/SBB, which contain low-equivalent uranium concentrations. Correlations were established based on two similar approaches for relating observed count rate in before- and after-logging field calibrations to equivalent uranium concentrations. A new field source (Ra-20S-82) was fabricated to replace the old source (Ra-20S-204), whose activity led to variable field calibration results previously caused by a nonfixed geometry. A cross-calibration study was performed to compare the operation of the new source relative to the old source. A digitally based collection/recording system was recently acquired, so that many of the procedures were performed with the old analog system and the new digital system to compare the performance of the digital system. 7 refs., 2 figs., 9 tabs.

**33810** (Y/ER–18/R1) **Interim action proposed plan: Mercury tank remediation in the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee.** Van Ryn, F.R. Oak Ridge National Lab., TN (United States). HAZWRAP Support Contractor Office. Jul 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. (ES/ER–21-D3). Order Number DE91019050. Source: OSTI; NTIS; GPO Dep.

The Oak Ridge Y-12 Plant is located adjacent to the city of Oak Ridge in Anderson County, Tennessee. The plant was constructed in the 1940s and primarily makes nuclear weapons components. In 1953, the Y-12 Plant was involved in the first production-scale separation of lithium isotopes for the development of hydrogen bombs. The lithium separation process involved separating the $^{6}Li$ isotope from the $^{7}Li$ isotope. A column-exchange (Colex) process that used mercury as the solvent was developed to extract the $^{6}Li$ isotope. Mercury spills resulting from the lithium separation process have been documented. Mercury from these spills found its way into sumps in the basement fan rooms of the two buildings. Mercury and mercury-contaminated sediment was then pumped from the

basements, passed through the tanks, and entered the storm sewer system. Floor drains in each building also drained into the the storm sewer system and through the tanks. These tanks also received discarded acid wash that resulted from washing mercury with a water/nitric acid solution. These mechanisms account for the majority of mercury and mercury-contaminated sediment contained in the tanks. Water sampling indicates that finely divided, mercury-contaminated sediment is still being discharged from the sumps in the fan rooms of Buildings 9201-4 and 9201-5 and into the tanks. This proposed plan identifies the preferred interim remedy to reduce the amount of mercury-contaminated sediment and elemental mercury entering the storm sewer system from three tanks. 3 figs., 1 tab.

## 0550 Safeguards, Inspection, and Accountability

*Refer also to citation(s) 33727, 33768, 34594, 34946, 34950*

**33811** (ANL/CP–72005) **Experience with fast calorimeters at Rocky Flats.** Perry, R.B. (Argonne National Lab., IL (United States)); Donohoue, T. Argonne National Lab., IL (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910901–7: 4. international conference on facility operations/safeguards interface, Albuquerque, NM (United States), 29 Sep - 4 oct 1991). Order Number DE91018550. Source: OSTI; NTIS; GPO Dep.

Two fast air chamber calorimeters developed by Argonne National Laboratory have been installed at the EG&G Rocky Flats Plant. Each of these instruments is capable of measuring more samples in one day than the water bath calorimeters currently in use can measure in a week. Average measurement time for plutonium samples packed in 8802 Vollrath cans (12.4 cm D x 17.8 cm H) is less than 20 minutes. Measurement precision and accuracy is estimated to be 0.004 watts or 0.2% for samples above 2 watts. 5 refs., 2 figs., 1 tab.

**33812** (BNL–46540) **Overview of seismic panel activities.** Bandyopadhyay, K.K. Brookhaven National Lab., Upton, NY (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9110122–6: Natural phenomena hazards mitigation conference, St. Louis, MO (United States), 15-18 Oct 1991). Order Number DE91018726. Source: OSTI; NTIS; INIS; GPO Dep.

In January 1991, the DOE-EM appointed a Seismic Panel to develop seismic criteria that can be used for evaluation of underground storage tanks containing high level radioactive wastes. The Panel expects to issue the first draft of the criteria report in January 1992. This paper provides an overview of the Panel's activities and briefly discusses the criteria. 3 refs.

**33813** (KFK–4866) **PROSA version 4.0 manual.** Bicking, U.; Golly, W.; Peter, N.; Seifert, R. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Datenverarbeitung in der Technik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Wiederaufarbeitung und Abfallbehandlung. May 1991. 92p. (PWA–16/91). Order Number DE92714346. Source: OSTI; NTIS (US Sales Only); INIS.

FORTRAN 77.

This report includes a comprehensive manual of the computer program PROSA which illustrate the handling and functioning of PROSA. The manual PROSA 4.0 (FORTRAN 77) describes the PC Version of PROSA including its program moduls. The PROSA program package is a statistical tool to decide on the basis of statistical assumptions whether in a given sequence of material balance periods a loss of material might have occurred. The evaluation of the material balance data is based on statistical test procedures. In the present PROSA Version 4.0 the three tests CUMUF test, PAGE's test and GEMUF test are applied to a sequence of material balances. PROSA Version 4.0 supports a real sequential evaluation. That means, PROSA is not only able to evaluate a series of MUF values sequentially after the campaign has finished, but also real sequentially during the campaign. PROSA Version 4.0 is a menu-guided computer program. Data input can be performed either by diskette or by key-enter. Result output is primarily an information whether or not an alarm is indicated. This information can be displayed either numerically or graphically. Therefore, a comfortable graphical output utility is attached to PROSA 4.0. The program moduls are compiled and linked with the Ryan Mc-Farland Compiler. The PROSA graphical utility uses the PLOT88 Library of Plotworks, Inc. (orig./HP).

**33814** (LA-UR–91-2790) **Design and use of SNM transportation systems at the Los Alamos National Laboratory.** Tellier, L.L. Los Alamos National Lab., NM (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9108154–1: American Glovebox Society annual conference and equipment show, Nashville, TN (United States), 26-29 Aug 1991). Order Number DE91018051. Source: OSTI; NTIS; INIS; GPO Dep.

The Plutonium Processing Facility at the Los Alamos National Laboratory is located in a building containing approximately 63,000 square feet of laboratory space with an additional 63,000 feet of basement area that is used for heating, ventilation, filtering, storage, and other "house" systems. The building's upper floor is set up in four separate wings with different types of processing occurring both within each wing and between the wings. Because of the diversity of these various processes, material must be moved within and across the various wings. Special Nuclear Material, hereafter referred to as SNM, must always be handled in an enclosed container in order to protect the environment and the workers who are using the material. In order to avoid making repeated transfers of material by an external means, LANL has designed a system whereby most of the wings and rooms in the Plutonium Facility are interconnected by a series of tunnels through which a transportation system or "trolley" operates. This tunnel serves a dual purpose in that it also supplies dry air to the gloveboxes. The tunnels extend the entire length of the building in each wing making a total of four tunnels with an additional tunnel installed such that it connects all four wing tunnels to each other. It can readily be seen that this also creates a problem in that a "chimney" now exists which can cause a fire to spread rapidly from one line or area to another. LANL has designed a series of air and mechanically operated fire doors that are located throughout the tunnel system to prevent this occurrence from happening. Double dropboxes are located at the end of each wing tunnel where the cross tunnel connects. Here, material can be off loaded from a wing trolley and on loaded to the cross trolley for further movement to any other area where it may be needed.

**33815** (LA-UR–91-2879) **Measurement control: Principles and practice as applied to nondestructive assay.** Sampson, T.E. Los Alamos National Lab., NM (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910901–13: 4. international conference on facility operations/safeguards interface, Albuquerque, NM (United States), 29 Sep - 4 oct 1991). Order Number DE92000307. Source: OSTI; NTIS; GPO Dep.

This paper discusses the principles and practice of measurement control for nondestructive assay (NDA) instruments. The NDA is not always blessed with the highly controlled samples that are assumed in the analytical laboratory. This adversely affects the use and applicability of the historical error information from instrument stability checks to estimate measurement uncertainties for the broad range of sample characteristics presented to most NDA instruments. This paper emphasizes the methods used to perform instrument stability checks and discusses the resulting uncertainty information that can be derived from these measurements. 4 refs., 2 figs., 2 tabs.

**33816** (LA-UR–91-3081) **A high-efficiency neutron coincidence counter for small samples.** Miller, M.C.; Menlove, H.O.; Russo, P.A. Los Alamos National Lab., NM (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910901–9: 4. international conference on facility operations/safeguards interface, Albuquerque, NM (United States), 29 Sep - 4 oct 1991). Order Number DE92000183. Source: OSTI; NTIS; INIS; GPO Dep.

The inventory sample coincidence counter (INVS) has been modified to enhance its performance. The new design is suitable for use with a glove box sample-well (in-line application) as well as for use in the standard at-line mode. The counter has been

redesigned to count more efficiently and be less sensitive to variations in sample position. These factors lead to a higher degree of precision and accuracy in a given counting period and allow for the practical use of the INVS counter with gamma-ray isotopics to obtain a plutonium assay independent of operator declarations and time-consuming chemicals analysis. A calculation study was performed using the Los Alamos transport code MCNP to optimize the design parameters. 5 refs., 7 figs., 8 tabs.

33817 (SAND–91-0077) **Accelerometer and strain gage evaluation.** Ammerman, D.J.; Madsen, M.M.; Uncapher, W.L.; Stenberg, D.R.; Bronowski, D.R. Sandia National Labs., Albuquerque, NM (United States). 19 Jun 1991. 216p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (TTC–1053). Order Number DE92000191. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the method developed by Sandia National Laboratories (SNL) to evaluate transducer used in the design certification testing of nuclear material shipping packages. This testing project was performed by SNL for the Office of Civilian Radioactive Waste Management (OCRWM). This evaluation is based on the results of tests conducted to measure ruggedness, failure frequency, repeatability, and manufacturers' calibration data under both field and laboratory conditions. The results of these tests are provided and discussed. The transducer were selected for testing by surveying cask contractors and testing facilities. Important insights relating to operational characteristics of accelerometer types were gained during field testing. 11 refs., 105 figs., 16 tabs.

33818 (WHC-SA–1129) **Operating experience: A first generation integrated safeguards system.** McRae, L.P.; Six, D.E. Westinghouse Hanford Co., Richland, WA (United States). Jul 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-910774–83: 32. Institute of Nuclear Materials Management (INMM) annual meeting, New Orleans, LA (United States), 28-31 Jul 1991). Order Number DE91018141. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In 1987, Westinghouse Hanford Company began operating a first-generation integrated safeguards system in the Plutonium Finishing Plant storage vaults. This Vault Safety and Inventory System is designed to integrate data into a computer-based nuclear material inventory monitoring system. The system gathers, in real time, measured physical parameters that generate nuclear material inventory status data for thousands of stored items and sends tailored reports to the appropriate users. These data include canister temperature and bulge data reported to Plant Operations and Material Control and Accountability personnel, and unauthorized item movement data reported to Security response forces and Material Control and Accountability personnel. The Westinghouse Hanford Company's experience and operational benefits in using this system to reduce radiation exposure, increase protection against insider threat, and real-time inventory control are discussed herein. 1 ref., 5 figs.

## 0560 Legislation and Regulations

*Refer also to citation(s) 34030, 34031, 34032, 34161, 34251*

33819 (PNL-SA–19894) **Status of existing federal environmental risk-based standards applicable to Department of Energy operations.** Bilyard, G.R. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-910981–16: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE92000146. Source: OSTI; NTIS; INIS; GPO Dep.

When conducting its environmental restoration, waste management, and decontamination and decommissioning activities, the US Department of Energy (DOE) must comply with a myriad of regulatory procedures and environmental standards. This paper assesses the status of existing federal risk-based standards that may be applied to chemical and radioactive substances on DOE sites. Gaps and inconsistencies among the existing standards and the technical issues associated with the application of those standards are identified. Finally, the implications of the gaps, inconsistencies, and technical issues on DOE operations are discussed, and approaches to resolving the gaps, inconsistencies, and technical issues are identified. 6 refs.

# 07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

## 0701 Physical Isotope Separation

33820 (LA-UR–91-2887) **Enhanced use of clips at the Los Alamos National Laboratory.** Duerre, K.H.; Parkinson, W.J.; Osowski, J.J. Los Alamos National Lab., NM (United States). [1991]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109280–1-Draft: 2. annual CLIPS conference, Houston, TX (United States), 23-25 Sep 1991). Order Number DE92000305. Source: OSTI; NTIS; GPO Dep.

Early efforts in producing Expert Systems for engineering applications used a limited subset of CLIPS features. We discuss implementation details of previous Expert Systems and the current Expert System used for training operators in the control of the Isotope Separation System. 4 refs., 8 figs.

## 0702 Radiation Sources

*Refer also to citation(s) 34739, 34747, 34753, 34754, 34755, 34760, 34761, 35456*

33821 (CONF-9109176–1) **A new clinical prototype tungsten-188/rhenium-188 generator to provide high levels of carrier-free rhenium-188 for radioimmunotherapy (RAIT).** Knapp, F.F. Jr. (Oak Ridge National Lab., TN (United States)); Mirzadeh, S.; Callahan, A.P.; Rice, D.E.; Lisic, E.C. Oak Ridge National Lab., TN (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual congress of the European Association of Nuclear Medicine; Vienna (Austria); 1-5 Sep 1991. Order Number DE91018853. Source: OSTI; NTIS; GPO Dep.

We have developed an efficient $^{188}W/^{188}Re$ alumina-based generator to provide carrier-free $^{188}Re$. This $^{188}Re$ will be used for direct-labeling of antibodies to be used for both radioimmunodiagnosis and radioimmunotherapy. Previous studies have involved small scale generators (< 10 mCi of $^{188}W$); the goal of the present study was to fabricate and test a clinical prototype generator (170–180 mCi $^{188}W$), an amount chosen to generate 40–75 mCi of $^{188}Re$/day. In order to investigate radiolysis in the alumina-based system, columns either remained in saline at all times ("wet") or had saline removed by an air stream after isotope elution ("dry"). Wet columns had a 40% yield after 2–3 days in saline, while dry columns had a yield of 60-75% after 2–3 days dry, indicating radiolysis may be decreasing the yield. Dry columns gave an average elution yield of 80–95%. The $^{188}W/^{188}Re$ system has proven to be useful in providing 100–200 mCi or higher levels of carrier-free $^{188}Re$ readily and consistently for labeling antibodies or other agents for therapeutic studies. 9 refs., 2 figs. (MHB)

33822 (INIS-SU–266, pp. 122-123) **Radiation-sorption processing of phenol-containing waters. Mathematical model of the process.** Dyagilev, S.A. (AN SSSR, Moscow (USSR). Inst. Ehlektrokhimii); Shubin, V.N.; Venitsianov, E.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. CHEMICAL EFFLUENTS/waste processing; PHENOLS/radiolysis; ADSORBENTS; ADSORPTION; CATALYSTS; CHEMICAL REACTION KINETICS; LIQUID WASTES; MATHEMATICAL MODELS; PHENOLS; RADIOLYSIS

**33823** (INIS-SU–266, pp. 141-142) **Arsenic recovery from waste water of arsenic production industry.** Mamardeshvili, M.I. (AN Gruzinskoj SSR, Tbilisi (USSR). Inst. Neorganicheskoj Khimii i Ehlektrokhimii); Abramishvili, N.V.; Basiladze, Ts.M.; Macheradze, G.P.; Tushurashvili, R.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CHEMICAL EFFLUENTS/chemical radiation effects; CHEMICAL EFFLUENTS/waste processing; ARSENIC; ARSENIC COMPOUNDS; CONTROLLED ATMOSPHERES; IONIZING RADIATIONS; OXIDATION; REDUCTION; WASTE WATER

**33824** (INIS-SU–266, pp. 147) **Study on thermoradiation sterilization of sewages.** Minigaliev, R.M.; Kolycheva, L.I.; Shubin, V.N.; Kabakchi, S.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. WASTE WATER/biological radiation effects; WASTE WATER/waste processing; GAMMA RADIATION; HEAT TREATMENTS; INACTIVATION; MEDIUM TEMPERATURE; MICROORGANISMS; RADIATION DOSES; SPORES

**33825** (INIS-SU–266, pp. 148-149) **Study of the process of radiation-adsorption disinfection of sewages.** Minigaliev, R.M.; Panteleev, V.I.; Kolycheva, L.I.; Shubin, V.N.; Brusentseva, S.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. WASTE WATER/biological radiation effects; WASTE WATER/waste processing; ADSORBENTS; ADSORPTION; AGRICULTURE; BIOLOGICAL WASTES; GAMMA RADIATION; IRRADIATION PLANTS; MICROORGANISMS; PILOT PLANTS; RADIATION DOSES; SPORES; STERILIZATION

**33826** (INIS-SU–266, pp. 150-151) **Radiation-adsorption removal of pesticides at the pilot plant for sewage processing.** Minigaliev, R.M.; Panteleev, V.I.; Shubin, V.N.; Brusentseva, S.A.; Danilin, D.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. WASTE WATER/chemical radiation effects; WASTE WATER/waste processing; ADSORPTION; AGRICULTURE; GAMMA RADIATION; IRRADIATION PLANTS; PESTICIDES; PILOT PLANTS

**33827** (NEI-FI–147) **Distribution of retention aid in the web of paper machine.** Manner, H. (Tampella Forest Oy, Inkeroinen (Finland)). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 31p. (In Finnish). Project KTM-128/881/88. Order Number DE92704027. Source: OSTI; NTIS (US Sales Only).

One of the main prerequisites for economic operation of paper machine is even distribution of various mixture components at the wet end and even distribution of all the material in paper web. This distribution is controlled e.g. by using chemical retention aids. Stable and undisturbed distribution of retention aid is then essential and should be to be verified by measuring techniques. For this purpose it was developed a measuring technique, which is based on a radioactive tracer. The technique was first developed, and later utilized, during five trial periods in PM 3 of Anjala Paper Mill. The technique was found well suitable for the purpose. Based on measured findings, a set of technical improvements was done in the flow system of the machine. E. g. dosage arrangements of retention aid were improved which resulted in improved operation of the paper machine.

**33828** (PNL-SA–19650) **Calculated production of high energy neutrons by 800 MeV protons.** Hawari, A.I. (Missouri Univ., Rolla, MO (United States)); Kumar, A.S.; Greenwood, L.R. Pacific Northwest Lab., Richland, WA (United States). Jun 1990. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-900623–27: 15. American Society for Testing and Materials (ASTM) international symposium on effects of radiation on materials. Nashville, TN (United States). 17-22 Jun 1990). Order Number DE91018220. Source: OSTI; NTIS; INIS; GPO Dep.

High Energy Transport Code calculations were performed for 800 MeV protons incident on thin targets of various materials. The objective was to enhance the fraction of high energy neutrons while maintaining a reasonable yield. A high yield of neutrons with energies greater than 100 MeV in comparison to neutrons in the MeV range can provide an experimental tool to study high energy neutron radiation damage effects, activation and other transmutation. It is shown that the preferential production of high energy neutrons requires the use of light nuclei such as boron or beryllium. This is due to the fact that the intranuclear cascades in light nuclei are small enough that very few nucleons share the energy of incoming particles. Furthermore, production of low energy neutrons is suppressed since neutrons are mainly produced by direct particle-neutron interactions in the target material. It is also shown that fairly large variations in the target thickness do not effect the neutron spectrum for all targets studied. This is because mean free paths of both incoming protons and outgoing neutrons are much larger than the target dimensions. In the current work an effort is made only to maximize the high energy neutron production in targets. However, to build a useful experimental facility for high energy neutrons one would need to calculate in detail the angular dependence of primary and secondary proton fluxes as well as scattered neutron fluxes from surrounding materials.

## 0703 Isotopic Power Supplies

**33829** (UCRL-JC–105761) **Thulium heat source for high-endurance and high-energy density power systems.** Walter, C.E.; Kammeraad, J.E.; Van Konynenburg, R.; VanSant, J.H. Lawrence Livermore National Lab., CA (United States). May 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-910801–23: 26. intersociety energy conversion engineering (IECE) conference, Boston, MA (United States), 3-9 Aug 1991). Order Number DE91018991. Source: OSTI; NTIS; INIS; GPO Dep.

We are studying the performance characteristics of radioisotope heat source designs for high-endurance and high-energy-density power systems that use thulium-170. Heat sources in the power range of 5–50 $kW_{th}$ coupled with a power conversion efficiency of ~30%, can easily satisfy current missions for autonomous underwater vehicles. New naval missions will be possible because thulium isotope power systems have a factor of one-to-two hundred higher endurance and energy density than chemical and electrochemical systems. Thulium-170 also has several other attractive features, including the fact that it decays to stable ytterbium-170 with a half-life of four months. For terrestrial applications, refueling on that time scale should be acceptable in view of the advantage

of its benign decay. The heat source designs we are studying account for the requirements of isotope production, shielding, and integration with power conversion components. These requirements are driven by environmental and safety considerations. Thulium is present in the form of thin refractory thulia disks that allow power conversion at high peak temperature. We give estimates of power system state points, performance, mass, and volume characteristics. Monte Carlo radiation analysis provides a detailed assessment of shield requirements and heat transfer under normal and distressed conditions is also considered. 11 refs., 7 figs., 4 tabs.

### 0705 Health and Safety

*Refer also to citation(s) 34055, 35041*

## 08 HYDROGEN

### 0808 Properties and Composition

**33830** (ENET–8900008/3) **Hydrogen in metals.** Schlapbach, L. (Fribourg Univ. (Switzerland). Inst. de Physique). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Jan 1991. 10p. (In German). Order Number DE92714217. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

In this final report of the project 'hydrogen in metals' results are presented in the following field: metal hydrides as electrodes, formation of ytterbium hydride in ytterbium films on palladium hydride substrates, formation and analysis of oxygen free layers of magnesium hydride, hydrides of magnesium-lithium alloys, electronic properties of calcium-palladium hydrides, adhesion coefficients of hydrogen on cerium, copper depositions on copper-zinc alloys after annealing in hydrogen, detection of heavy metals in aqueous solutions, usage of thin layers of rare earth metals as sorption pumps. 17 refs.

## 09 BIOMASS FUELS

### 0907 Resources

**33831** (WAOENG–91-10) **Washington State biomass data book.** Deshaye, J.A.; Kerstetter, J.D. Washington State Energy Office, Olympia, WA (United States). Jul 1991. 165p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000585. Source: OSTI; NTIS; GPO Dep.

This is the first edition of the Washington State Biomass Databook. It assess sources and approximate costs of biomass fuels, presents a view of current users, identifies potential users in the public and private sectors, and lists prices of competing energy resources. The summary describes key from data from the categories listed above. Part 1, Biomass Supply, presents data increasing levels of detail on agricultural residues, biogas, municipal solid waste, and wood waste. Part 2, Current Industrial and Commercial Use, demonstrates how biomass is successfully being used in existing facilities as an alternative fuel source. Part 3, Potential Demand, describes potential energy-intensive public and private sector facilities. Part 4, Prices of Competing Energy Resources, shows current suppliers of electricity and natural gas and compares utility company rates. 49 refs., 43 figs., 72 tabs.

### 0908 Production

*Refer also to citation(s) 33831, 33850*

**33832** (EUR–12949) **Agronomical trials with sweet sorghum.** Von Broock, R. (KWS Kleinwanzlebener Saatzucht AG, Einbeck (Germany)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; KWS Kleinwanzlebener Saatzucht AG, Einbeck (Germany). 1990. 40p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3B-0143-D(AM). Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Sweet Sorghum (Sorghum bicolor L. (saccharatum)) could serve as an alternative crop producing high yields in renewable energy. It can be used either to produce ethanol or sugar-syrup for industrial purposes. During three years experimental hybrids of Sweet Sorghum were tested in five local ions in Western Europe, to identify the adaptation of the available plant materials to the test areas. The experiments showed that in climatic suitable conditions top yielding varieties had the potential of more than 30 to/ha of dry matter and sugar yield exceed 10 to/ha while the sugar content generally stayed under 10%. The material tested so far is quite vulnerable to cold weather and lodging. This lead to large differences between the characters of single varieties from one location to the next in many cases. Results thus are very difficult to interpret. The need for stable and reliable yields requires early maturing and cold tolerant varieties with good lodging resistance. Comparable breeding work was successfully carried out by the maize breeders of Europe and there is no doubt that sweet sorghum should have the same potential. 5 figs., 27 tabs.

**33833** (EUR–13023) **Genetic improvement and modified conventional culture of forest trees for short term biomass production: Final report.** Teissier du Cros, E. (Institut National de Recherches Agronomiques (INRA), 45 - Olivet (France). Station d'Amelioration des Arbres Forestiers). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Institut National de Recherches Agronomiques (INRA), 45 - Olivet (France). Station d'Amelioration des Arbres Forestiers. 1990. 145p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3B-0041/F. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Poplar Short Rotation Forestry need to be based on permanently renewed clones with abilities specifically adapted to high planting density, strong disease risk, short rotation and frequent coppicing. INRA's improvement program is preparing new clones for the next decades. Alder, although not a high producing species, particularly on marginal soil, has a strong future in species mixed stands in which its nitrogen fixation will be optimized. The use of Quercus rubra in high yield coppice is based on the vegetative propagation of vigorous clones. Clones of Cyrptomeria japonica and Picea sitchensis have been selected and vegetatively propagated for clonal testing. Two conventional modified silvicultural models are being tested. Part of this research, particularly on poplar, is being extended to demonstration in different parts of France. 33 refs., 2 figs., 1 tab.

**33834** (NEI-DK–646) **Preliminary and post treatment of household wastes, sorted according to source, to be used for the production of biogas.** Jysk Biogas, Farsoe (Denmark). [1991] 15p. (In Danish). Contract ENS-UVE-90.0042;Contract ENS-UVE-90.0011. Order Number DE92703900. Source: OSTI; NTIS (US Sales Only).

Experiments were made with household wastes that had been sorted at the source. The aim was to ferment the sorted organic wastes together with manure in order to demonstrate simple, cheap and hygienic methods of fermentation to produce methane and fertilisers. The first phase described here includes a simple method of separating foreign bodies from the organic material and registration of the biological process during fermentation with manure. Preliminary treatment consists of mixing the organic wastes with degassed manure, separation using a grid-like seive and communition by means of a macerator. These processes are described in detail. (AB).

### 0909 Processing

*Refer also to citation(s) 33708, 33834, 34394, 35090*

**33835** (CIEMAT–665) **Effect of the steam explosion pretreatment on enzymatic hydrolysis of eucaliptus wood and sweet sorghum bagasse.** Negro, M.J.; Martinez, J.M.; Manero, J.;

Saez, F.; Martin, C. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1990. 33p. (In Spanish). Order Number DE92700007. Source: OSTI; NTIS (US Sales Only).

The effect of steam explosion treatment on the enzymatic hydrolysis yield of two different lignocellulosic substrates is studied. Raw materials have been pretreated in a pilot plant designed to work in batch and equipped with a reactor vessel of 2 1 working volume where biomass was heated at the desired temperature and then exploded and recovered in a cyclone. Temperatures from 190 to 230 C and reaction times from 2 to 8 min. have been assayed. The efficiency of the steam explosion treatment has been evaluated on the composition of the lignocellulosic materials as well as on their enzymatic hydrolysis yield using a cellulolytic complex from T. reesei. Results show a high solubilization rate of hemicelluloses and variable losses of cellulose and lignin depending on the conditions tested. Enzymatic hydrolysis yields of both substrates experimented remarkable increments, corresponding the highest values obtained to 210 C; 2 min. and 210 C; 4 min. for sorghum bagasse and eucaliptus wood respectively. (Author)

**33836** (ETSU-B–1234S) **The prospects for methane recovery from the anaerobic digestion of municipal solid waste in the UK: Summary of report.** Coombs, J. (CPL Scientific Ltd., Newbury (GB)). AEA Environment and Energy, Harwell (United Kingdom). 1990. 25p. Contract E/5A/CON/1234/1912. Order Number DE92709674. Source: OSTI; NTIS (US Sales Only).

The availability, composition and energy output of municipal solid wastes (MSW) in the United Kingdom are considered. The sorting of MSW, the production of organic fractions and the technical aspects of their biological consolidation are examined. A description of anaerobic digestion activities and pilot and commercial scale plants in the United Kingdom, the European Communities and the USA is given. Finally,the potential for electricity generation from, and the co-products, by-products and cost of, the anaerobic digestion of MWS are summarized. It is concluded that, on the basis of the evidence available, there appears to be a good case for government support aimed at boosting the waste treatment industry's confidence in the anaerobic digestion of the organic fraction of MSW in fabricated systems. A programme of field trials and related research is recommended. (UK).

**33837** (EUR–13088) **Eucalyptus globulus debarking plant: Demonstration project: Final report.** Tavares, S. (Soporcel, Figueira da Foz (Portugal)); Silveira, A.; Redondo, A. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Soporcel, Figueira da Foz (Portugal). 1990. 32p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract BM/77/86/PO. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5.

Eucalyptus is used at a number of pulp mills in Portugal and Spain. At present, bark is stripped manually in the forest and the bark is not utilized. The pre-treatment debarking unit being demonstrated consists of a number of toothed rotors which move at high speed constantly adjusting to the wood diameter, thereby reducing bark adhesion and breaking the bark's fibre structure. The average debarking efficiency obtained is below the objective value: 83.6% on average instead of 90% with a large variation from 53.4 to 98.1%. The higher efficiency values are reached when processing a high proportion of recently cut wood (up to 15 days). When processing dry wood, with a felling age between 1 and 3 months, the debarking efficiency will be 60% approx. However, the average efficiency values achieved lead to the conclusion that significant progress has been made in the Eucalyptus globulus debarking process. Besides, the pre-treatment unit has already been replicated in other Portuguese eucalyptus paper mills. 10 figs., 8 tabs.

**33838** (NEI-DK–636) **Comminution, storage and drying of wood fuels.** Hauge Nielsen, K. (ed.). Skovteknisk Inst., Copenhagen (Denmark). 1990 35p. (CONF-9003293–: IEA/BA TASK 6: activity 4 meeting - comminution, storage and drying of wood fuels, Firenze (Italy), 19-21 Mar 1990). Order Number DE92703880. Source: OSTI; NTIS (US Sales Only).

A collection of papers presented at a conference on wood fuel is presented. They deal with the subjects of the production, (harvesting) and especially drying and storage of wood for fuel. Brief descriptions of past, current and future research, with regard to the latter, are given in the cases of Denmark, Norway, the UK, Italy, Finland and Sweden. (AB).

**33839** (NEI-DK–636, pp. 11-12) **UK reserch on storage and drying of comminuted wood fuels.** Nellist, M.E. Skovteknisk Inst., Copenhagen (Denmark). 1990. 35p. (In Danish). (CONF-9003293–: IEA/BA TASK 6, activity 4 meeting, Firenze (Italy), 19-21 Mar 1990). In *Comminution, storage and drying of wood fuels.* Order Number DE92703880. Source: OSTI; NTIS (US Sales Only).

The research covered the areas of determination of properties of chips and chunks relevant to drying, mathematical modelling of the heat and mass transfer in bulks of chips and/or chunk and storage drying experiments on a near commercial scale. A brief survey of these activities in the UK is presented. (AB).

**33840** (NEI-DK–636, pp. 15-16) **Storage and drying of comminuted wood fuels.** Jirjis, R. (Swedish University of Agricultural Sciences, Dept. of Forest Products, Uppsala (SE)). Skovteknisk Inst., Copenhagen (Denmark). 1990. 35p. (In Danish). (CONF-9003293–: IEA/BA TASK 6, activity 4 meeting, Firenze (Italy), 19-21 Mar 1990). In *Comminution, storage and drying of wood fuels.* Order Number DE92703880. Source: OSTI; NTIS (US Sales Only).

The distribution of the use of wood fuels in Sweden is explained and current research on storage of bark/shavings mixtures and storage in covered wind rows is very briefly described. (AB).

**33841** (NEI-DK–636, pp. 17-21) **The effects of long term storage on the properties of whole-tree chips.** Nurmi, J. (Finnish Forest Research Institute, Kannus Research Station, Kannus (FI)). Skovteknisk Inst., Copenhagen (Denmark). 1990. 35p. (In Danish). (CONF-9003293–: IEA/BA TASK 6, activity 4 meeting, Firenze (Italy), 19-21 Mar 1990). In *Comminution, storage and drying of wood fuels.* Order Number DE92703880. Source: OSTI; NTIS (US Sales Only).

In additon to labour and material costs as well as interest losses, the long-term storage of fuel chips in large quantities will cause significant drymatter losses and reductions in total energy content. However, it is necessary to use buffer storages in climates where snow and cold prevents contractors from supplying heating facilities in the most severe winter conditions. The purpose of this study was to find ways of reducing these disadvantages as much as possible. The study location chosen was on the southwest side of the Lokka reservoir in Sodankylae at latitude 68 degrees north. The material for the study happened to be readily available here. It is also one of the coldest areas of the country providing a great need for heating. The town itself has a 20MW heating plant which operates on fuel chips. (author).

**33842** (NEI-DK–636, pp. 22-35) **Fuelwood consumption in Italy: Current preparation techniques and ongoing research.** Baldini, S. (Wood Research Institute (IT)); Spinelli, R. Skovteknisk Inst., Copenhagen (Denmark). 1990. 35p. (In Danish). (CONF-9003293–: IEA/BA TASK 6, activity 4 meeting, Firenze (Italy), 19-21 Mar 1990). In *Comminution, storage and drying of wood fuels.* Order Number DE92703880. Source: OSTI; NTIS (US Sales Only).

A survey of forest locations and potentials in Italy and a description of wood fuel production illustrated by graphs on prices and amounts. National policy regarding the utilization and marketing of wood fuels is touched upon and past, present and future research on the harvesting drying and storage of wood for fuel is described. (AB).

## 0910 Properties and Composition

*Refer also to citation(s) 33845*

**33843** (VTT-TIED–1189) **Non-destructive measurement of wood characteristics: Part 4 Gamma ray measurement of wood diffusivity and capillarity.** Ojanen, T. (Valtion Teknillinen

Tutkimuskeskus. Espoo (Finland). LVI-tekniikan Laboratorio). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Nov 1990. 65p. (In Finnish). Order Number DE92704040. Source: OSTI; NTIS (US Sales Only).

Gamma radiation absorption measurement is a reliable method to produce the required data for determination of moisture transport properties of porous building materials. Moisture contents of a test sample is determined at different time increments during a 1-dimensional moisture transport process. The amount of measurements of moisture contents for one test specimen is almost unlimited when using the gamma-ray method. This also permits the determination of the differences between moisture transport properties of different test samples, which is important with inhomogenous materials such as wood. The moisture contents fields for wetting of pine and spruce were measured using gamma radiation absorption method. Moisture diffusivity and capillarity (capillary suction of water mass in time) were determined. Moisture transport process was studied along the wood grain and against the grain using test samples with different densities cut from sapwood or heartwood. Test samples from the inside part of a tree had a strong distribution in local densities, the difference of which could be even 70 kg/$m^3$ in one specimen. The corresponding value for test samples from surface parts of a tree were no more than 20 kg/$m^3$. Also the measured moisture fields showed the inside parts of a tree to be much more inhomogenous than the surface parts. The capillarity values illustrate best the differences between moisture transport properties of different wood qualities. Moisture diffusivities, which are used in numerical simulation of building physical problems, are presented as functions of moisture contents by figures and coefficients of functional fits.

## 0920 Combustion

*Refer also to citation(s) 34381*

**33844** (ETSU-B–7052S) **A review of the engineering foundation conference on fireside problems while incinerating municipal and industrial waste.** Anjum, A. (Foster Wheeler Power Products Ltd., London (United Kingdom)). AEA Environment and Energy, Harwell (United Kingdom). 1990. 48p. Contract E/5A/CON/1234/1912. (CONF-8910545–1: Conference on fireside problems while incinerating municipal and industrial waste, Sheraton Palm Coast, U (United States), 8-12 Oct 1989). Order Number DE92709675. Source: OSTI; NTIS (US Sales Only).

This report gives a review of the Engineering Foundation Conference on Fireside problems in Waste Incineration. The overall message was that almost all units that burn Municipal Solid Waste (MSW) fuel, whether prepared or unprepared, tend to suffer from chloride induced corrosion problems. The extent and location of the problem areas differ somewhat, depending on steam conditions and boiler design. Causes of tube failure are now better understood than in previous years. Nevertheless the problems have persisted and work is going on to remedy the situation by design changes, operational control optimisation and by the use of corrosion resistant materials. (author).

**33845** (NEI-DK–639) **Modeling and chemical reactions: Development and test of reduced chemical kinetic mechanism for combustion of methane.** Lilleheie, N.I. (SINTEF/The Norwegian Institute of Technology (NO)); Byggstoeyl, S.; Magnussen, B.F.; Kilpinen, P.; Hupa, M.; Glarborg, P. Nordisk Gasteknisk Center, Hoersholm (Denmark). May 1991 134p. Order Number DE92703890. Source: OSTI; NTIS (US Sales Only).

Combustion in practical systems takes place in turbulent flow. There is a growing need for models that can predict various parameters in turbulent combustion. For a number of problems the combustion chemistry can be represented successfully by very simple means, such as equilibrium or global models. To solve problems such as extinction and pollutant formation, however, it is important to be able to handle finite rate chemistry in the turbulent models. The turbulence models based on the "Eddy dissipation Concept" of B.F. Magnussen have previously been extended to handle complex chemistry in turbulent combustion. However, for practical 3-D problems minimization of CPU-time consumption and memory needed is critical. Therefore there is a need for a description the chemistry, which is intermediate between global models and the large, multistep mechanisms. This report documents the development and test of a systematically reduced chemical model for methane oxidation. We have adopted a reduced scheme for methane flames and modified it to provide a better description of certain minor species and radicals, important for the nitrogen chemistry. We have implemented the nitrogen chemistry in the reduced mechanism and tested the ability of the scheme to describe the oxidation process as well as formation and destruction of $NO_x$ in methane combustion in a perfectly stirred reactor by comparing with results obtained with the full kinetic model. Calculations have been performed for turbulent diffusion methane flames and results obtained with reduced scheme and full kinetics, respectively, have been compared with experimental data. (author) 36 refs.

## 0930 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 33831, 34241*

**33846** (DOE/OR/21389–32) **Northeast Regional Biomass Program: Mission, accomplishments, prospects, 1991.** CONEG Policy Research Center, Inc., Washington, DC (United States). Mar 1991. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-83OR21389. Order Number DE91018706. Source: OSTI; NTIS; GPO Dep.

This 1991 Report contains an update on the mission, goals and accomplishments of the Northeast Regional Biomass Program (NRBP). It describes the activities conducted during the past two years and incorporates the information contained in the 1989 publication of the NRBP Five Year Report. It describes the biomass projects conducted by the individual states of the Northeast Region, and summarizes the results from the Program's technical studies. Publications from both the state and regional projects are listed as well. An appendix lists the biomass-fired electricity generating stations planned or in operation in the region. The NRBP began in 1983 by developing a five year plan to guide its work. Within that time frame, the NRBP undertook over 20 applied research and technology transfer projects, and supported and guided the work of its eleven member states. During and since that period, the NRBP has brought together public and private sector organizations to promote the use in the Northeast of biomass and municipal waste energy resources and technologies. The NRBP's long-range plan was updated in 1990. In light of the accomplishments of the NRBP and the remaining challenges, this Report considers directions for future efforts. The Northeast has abundant biomass resources and markets for their use as energy. Meeting this potential will contribute to reducing the atmospheric greenhouse effect and dependence on imported oil. 49 refs.

**33847** (DOE/OR/21389–33) **Northeast regional biomass energy program: Progress report, April–June 1991.** O'Connell, R.A. CONEG Policy Research Center, Inc., Washington, DC (United States). Jul 1991. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-83OR21389. Order Number DE91018707. Source: OSTI; NTIS; GPO Dep.

The management structure and program objectives for the Northeast Regional Biomass Program (NRBP) remain unchanged from previous years. The funding for the eighth year is $600,000. An additional $60,000 was provided by the Bonneville Power Administration Regional Biomass Program to continue the publication of articles in the Biologue. The Western Area Power Administration and the Council of Great Lakes Governors provided $20,000 each for funding the project "Characterization of Emissions from Burning Woodwaste." A grant request has been submitted to DOE for the ninth year of operation in the amount of $775,000. This amount includes $22,000 from TVA for the aforementioned project. The Northeast Regional Biomass Steering Committee selected the following five projects for funding for the next fiscal year: (1) the wood waste utilization conference; performance evaluation of wood systems in commercial facilities; wood energy market utilization training; update of some previous publications; and wood chip energy decision-making guidebook. Work statements are being prepared and RFP will be issued where appropriate. CONEG also

negotiated a contract with the National Wood Energy Association for publication of three issues of the Biologue magazine.

**33848** (NEI-DK–636, pp. 9-10) **Denmark.** Heding, N. Skovteknisk Inst., Copenhagen (Denmark). 1990. 35p. (In Danish). (CONF-9003293–: IEA/BA TASK 6, activity 4 meeting, Firenze (Italy), 19-21 Mar 1990). In *Comminution, storage and drying of wood fuels.* Order Number DE92703880. Source: OSTI; NTIS (US Sales Only).

Short communication. WOOD FUELS/denmark; WOOD FUELS/energy policy; DENMARK; DISTRICT HEATING; TAXES; RESEARCH PROGRAMS; STORAGE

### 0940 Transport, Handling, and Storage

*Refer also to citation(s) 33848*

### 0950 Environmental Aspects

**33849** (DOE/RL–01830T-H9) **Processes for identifying regional influences of and responses to increasing atmospheric $CO_2$ and climate change—The MINK Project: Report 3, Forest resources.** Bowes, M.D.; Sedjo, R.A. Resources for the Future, Inc., Washington, DC (United States). Aug 1991. 123p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7542). Order Number DE91018604. Source: OSTI; NTIS; GPO Dep.

This is the third of a series of reports of research contributing to the study Processes for Identifying Regional Influences of an Responses to Increasing Atmospheric $CO_2$ and Climate Change –The MINK Project. This report is an analysis of the possible impacts of climatic change on forest resources in the Missouri-Iowa-Nebraska-Kansas (MINK) region. It follows a uniform methodological strategy that is applied to the four resource sectors most likely to be impacted by climate change, i.e. agriculture, forestry, water resources and energy. What makes the forests of this region interesting is their great vulnerability to climate warming. With their position on the fringe of the eastern hardwood forest, bordering the grasslands of the midwest, it might be expected that these forests would be among the first to be affected by a changing climate. The state of the current forest resource are examined as well as, using simulation models, the likely sensitivity of the Missouri forests to a climate warming. The future development of forestry and forest technology in the region is considered. It is concluded that the low productivity of these forests rules out active adaptation to climate change, such as might expected in the region's agricultural sector or in the more productive forest regions of the US southeast or northwest. The forest sector is most likely to begin gradual and passive decline under a climate warming. 47 refs., 27 figs., 7 tabs.

### 0960 Health and Safety

**33850** (NEI-DK–637) **Veterinary research, monitoring and advisory services in connection with the establishment and operation of a communal biomass conversion plant. Partial project 3 (VET-BIO-3): Pilot project concerning the establishment of the surveying of diseases contracted in connection with communal biomass conversion plants.** Willadsen, C.M. Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Inst. for Husdyrbrug- og Husdyrsundhed. Jun 1991 331p. (In Danish). Contract TR-87.250. Order Number DE92703887. Source: OSTI; NTIS (US Sales Only).

The health of domestic animals which contribute to thermophilic biomass conversion plants has been monitored during a period of 15-18 months. The aim was to evaluate the possible risk of infection by animal diseases through liquid manures which are converted in the plants. Data from 39 stocks has been collected and evaluated for the surveilliance of the general health conditions and the occurrence of specific germs, for cattle Salmonella Dublin, and for swine Actinobacillus pleuropneumiae (serotype 2) and Treponema hyodysenteriae. (CLS) 24 refs.

### 0980 Waste Management

*Refer also to citation(s) 33836, 33847*

### 0990 Products and By-Products

*Refer also to citation(s) 33831*

## 10 SYNTHETIC FUELS

### 1002 Production

*Refer also to citation(s) 33563, 33707, 33708, 33709, 33710, 33711, 33712, 33715, 33716*

**33851** (DOE/METC–91/6117, pp. 270-275) **Methane to methanol conversion.** Danen, W.C. (Los Alamos National Lab., NM (USA)); Lyman, J.L.; Oldenborg, R.C.; Rofer, C.K.; Ferris, M.J. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The objective of this research effort is to understand the fundamental chemistry necessary to develop a process to effect the partial oxidation of methane to methanol using air or oxygen. The goal is to develop an economically viable process to convert natural gas or methane from mild coal gasification products to a liquid fuel that is readily transported. During the course of the research effort, the authors have employed an integrated, multidisciplinary approach using state-of-the-art theoretical and experimental tools including computer kinetic modeling, fundamental kinetics measurements, theoretical rate constant calculations, bench-scale reactor experiments, and systems analysis. They have made significant advances in understanding the detailed chemistry of the reactive intermediates and of the possible reaction pathways under various conditions and have been able to specify the reaction parameters necessary to obtain high yields of methanol. Major accomplishments to date are summarized.

### 1007 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 34403*

## 13 HYDRO ENERGY

### 1305 Economic, Industrial and Business Aspects

*Refer also to citation(s) 34241*

### 1306 Environmental Aspects

**33852** (DOE/BP/16480–5) **Development of a vaccine for bacterial kidney disease in salmon: Final report.** Kaatari, S.; Turaga, P.; Wiens, G. Oregon State Univ., Corvallis, OR (United States). Dept. of Microbiology. Aug 1989. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-84BP16480. Order Number DE92000910. Source: OSTI; NTIS; GPO Dep.

This document is the executive summary and background review for the final report of "Development of a Vaccine for Bacterial Kidney Disease in Salmon". A description of the disease is provided, with microbiological characterization of the infective agent. A brief discussion of attempts to eradicate the disease is included. Recent progress in vaccine development and attempts to control the disease through pharmacological means are described, along with potential ways to break the cycle of infection. 80 refs. (MHB)

**33853** (DOE/BP/63461–5) **Augmented fish health monitoring: Completion report (Part one of two volume): Volume 1.** Michak, P. (Washington Dept. of Fisheries, Olympia, WA (United

States)); Rogers, R.; Amos, K. USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife; Washington Dept. of Fisheries, Olympia, WA (United States). May 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract BI79-86BP63461. Order Number DE92000912. Source: OSTI; NTIS; GPO Dep.

The Bonneville Power Administration (BPA) initiated the Augmented Fish Health Monitoring project in 1986. This project was a five year interagency project involving fish rearing agencies in the Columbia Basin. Historically, all agencies involved with fish health in the Columbia Basin were conducting various levels of fish health monitoring, pathogen screening and collection. The goals of this project were; to identify, develop and implement a standardized level of fish health methodologies, develop a common data collection and reporting format in the area of artificial production, evaluate and monitor water quality, improve communications between agencies and provide annual evaluation of fish health information for production of healthier smolts. This completion report will contain a project evaluation, review of the goals of the project, evaluation of the specific fish health analyses, an overview of highlights of the project and concluding remarks. 8 refs., 1 fig., 4 tabs.

# 14 SOLAR ENERGY

## 1403 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 34241*

## 1405 Solar Energy Conversion

*Refer also to citation(s) 33857, 33900, 35090, 35482*

**33854** (DOE/CH/10093–113) **Photovoltaics: New opportunities for utilities.** Solar Energy Research Inst., Golden, CO (United States). Jul 1991. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE91002168. Source: OSTI; NTIS; GPO Dep.

This publication presents information on photovoltaics. The following topics are discussed: Residential Photovoltaics: The New England Experience Builds Confidence in PV; Austin's 300-kW Photovoltaic Power Station: Evaluating the Breakeven Costs; Residential Photovoltaics: The Lessons Learned; Photovoltaics for Electric Utility Use; Least-Cost Planning: The Environmental Link; Photovoltaics in the Distribution System; Photovoltaic Systems for the Rural Consumer; The Issues of Utility-Intertied Photovoltaics; and Photovoltaics for Large-Scale Use: Costs Ready to Drop Again.

**33855** (SERI/CP–2360-4494) **Fifteenth DOE solar photochemistry research conference: Proceedings.** National Renewable Energy Lab., Golden, CO (United States). [1991]. 243p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-9106213–: 15. Department of Energy (DOE) solar photochemistry research conference, Snowmass, CO (United States), 2-6 Jun 1991). Order Number DE91015008. Source: OSTI; NTIS; GPO Dep.

The annual Solar Photochemistry Research Conference brings together contractors and grantees of the Division of Chemical Sciences engaged in fundamental research on solar photochemical energy conversion to exchange information on recently completed studies, research in progress, and future plans. The meeting also provided an opportunity for interested representatives of government and industry to assess the current status of the field. The program encompassed the themes of photoelectrochemistry, organic and inorganic photochemistry, supramolecular assemblies, solvent effects on electron transfer, and photosynthesis. This year, in an effort to provide an overview on solar photochemical energy conversion to new participants and to foster a cohesive approach in problem solving, a panel discussion was added, in which the panelists addressed the current status of the field and identified propitious pathways in solar photochemistry.

**33856** (SERI/TP–214-4405) **Research on stable, high-efficiency, amorphous silicon multijunction modules: Annual subcontract report, 1 May 1990–30 April 1991.** Catalano, A. (Solarex Corp., Newtown, PA (United States). Thin Film Div.); Bennet, M.; Chen, L.; Fieselmann, B.; Li, Y.; Newton, J.; Podlesny, R.; Wiedeman, S.; Yang, L. Solar Energy Research Inst., Golden, CO (United States); Solarex Corp., Newtown, PA (United States). Thin Film Div. Aug 1991. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE91015002. Source: OSTI; NTIS; GPO Dep.

The present effort seeks to develop modules with a stabilized performance of 8.8% aperture area conversion after 600 hours light exposure (AM1.5) at 50°C in modules with aperture areas over 900 $cm^2$. Good progress towards this goal has been obtained with the demonstration of 9.8% initial performance in a submodule incorporating devices with relatively thin middle junction i-layer thickness of 4000Å. Devices with this design have been shown to lose about 10% of their initial performance after 1000 hours of exposure. Modules lose between 18–23% largely due to light induced shunting, probably related to the contact metallization. Achieving long-term stabilized efficiencies of 12% or more requires substantial improvements in materials and devices. Our analysis has shown that substantial optical losses occur at both front and rear contacts which we hope to address with ZnO films prepared by CVD and sputtering processes now under development. Further progress is doped layers and alloys are also needed. Fundamental studies of the relationship between material structure and processes (particularly the effect of hydrogen dilution) are reported here. 32 refs., 28 figs., 9 tabs.

## 1406 Photovoltaic Power Systems

*Refer also to citation(s) 33854*

**33857** (ALS/TR–91-010) **Technical specifications for photovoltaic systems for residential lighting in rural areas.** Huacuz V, J.M. (Instituto de Investigaciones Electricas, Cuernavaca (Mexico)); Martinez L, A.M.; Becerra L, H. Sandia National Labs., Albuquerque, NM (United States). 13 May 1991. 61p. Translation of IIE/01/14/2929/I-02/F, January 1991. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91017635. Source: OSTI; NTIS; GPO Dep.

One of the most attractive applications of photovoltaic cells at this time is the lighting of areas that are difficult to supply with the electric grid. For this application, the cells are integrated into photovoltaic modules rated a few tens of Watts (W) and capable to provide enough electricity for lighting purposes during several hours every day. Recently, this approach has been used by state or federal programs to supply lighting power to rural communities in the country. There are already several thousands of installed systems and this number is expected to grow. This is the reason for the need to establish the present Specification, in order to reduce the risk of failure of the associated equipment and systems and to standardize as much as possible the method for their integration and installation. 2 figs.

**33858** (SERI/CP–250-4254-Vol.2, pp. 303-322) **PV central receivers: Their potential role in solar-electric generation.** Swanson, R.M. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

The attractiveness of central receiver photovoltaic systems stems from a combination of factors. First, heliostats have had considerable development under the Federal solar-thermal program. They constitute the lowest cost means of concentration. Second, SunPower has developed a photovoltaic dense-array receiver capable of operating at 30 watts per square centimeter. By centralizing the electric generation in a high-power central-receiver the costs associated with having generation distributed over a large field are reduced. Finally, the high-efficiency of recently-developed silicon solar cells begin to approach that of conventional heat engines, but without their complexity and operating costs. SunPower intends to market photovoltaic central-receiver power plants at under $2.00 per watt by 1995.

## 1407 Solar Thermal Power Systems

*Refer also to citation(s) 33901, 34272*

**33859** (SERI/CP–250-4254-Vol.2, pp. 161-183) **The LUZ SEGS plants: Current status and future plans.** Kearney, D. (LUZ International Ltd. Los Angeles, CA (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

This paper describes the previous applications of LUZ collectors and the application of their system at Harper Lake. The systems are described, the cost of solar electric generating systems are reviewed, the efficiency and performance reviewed and the projected vs actual gross electricity generation is compared. Projected designs such as a solar/combined cycle are described.

**33860** (SERI/CP–250-4254-Vol.2, pp. 185-208) **Development of an industry consortium to build a central receiver power plant.** Kolb, G.J.; Chavez, J.M.; Alpert, D.J. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

For 15 years, the Department of Energy has worked with industry, both utilities and vendors, to develop the technology of solar central receiver power plants. In this type of power plant, sunlight is concentrated by a field of sun-tracking mirrors onto a centrally located receiver on top of a tower. The solar energy is collected by the receiver in the form of a heated fluid, which is used to generate steam to power a conventional turbine/generator. In recent years, the use of a molten-nitrate salt has emerged as the preferred heat transfer fluid. The advantage of using salt is that it provides a simple and cost-effective energy storage system. This energy storage system gives central receivers unique advantages over other solar technologies: (1) electricity can be dispatched when desired (even at night) to meet the needs of the utility grid, and (2) plants can be cost-effectively designed with annual capacity factors ranging from 25 to over 60%, without using fossil fuels. In addition to these unique advantages, studies performed by industry predict that these plants will produce the lowest cost electricity of any utility-scale solar power plant that can be built with today's technology. Sandia National Laboratories is helping the utility industry form a consortium to build the pilot plant. This is being done by meeting with utilities, IPPs, energy commissions, public utility commissions, and environmental regulatory groups located in the sunbelt states. To date, several groups have been identified that appear interested in contributing to such a project.

**33861** (SERI/CP–250-4254-Vol.2, pp. 231-247) **The Hawaii experience: Problems with geothermal energy development and the growing opportunities for solar thermal electric technology.** Trenka, A.R. (Pacific International Center for High Technology Development, Honolulu, HI (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

Exploration for geothermal energy for producing electricity has been conducted for 30 years in Hawaii. In 1976 the first successful geothermal well was completed, and a 3 MW demonstration plant was completed in 1981 on the Big Island. This plant operated for eight years and demonstrated that electrical power could be generated on an active rift zone on the Island of Hawaii. This accomplishment appears to indicate that the development of geothermal energy on a large scale would be readily feasible, and a number of geothermal developers began preparations to construct commercial power plants. However, a series of environmental, technical, economic, cultural, and social barriers to development have been encountered. Operation of the demonstration well has been terminated, and although several exploratory geothermal wells have been drilled on the Kilauea East Rift Zone, developers have not succeeded in completing a commercial geothermal power plant to date. Public resistance to large-scale geothermal development and a plan to transmit power from geothermal plants on the Big Island to other islands in the state, combined with the economic and technical problems that have plagued the effort, have resulted in an opinion by some energy planners that other renewable energy technologies, in particular concentrated solar thermal technology, should be investigated as a means of electricity production to reduce Hawaii's high dependence on imported fuels. Although the market for electricity from alternative sources on the Big Island is limited, opportunities for solar thermal energy development appear most favorable on other islands such as Maui, Oahu, Molokai, Lanai, and possibly Kauai.

**33862** (SERI/CP–250-4254-Vol.2, pp. 275-278) **How solar electric technology may help alleviate severe electricity shortages in the Dominican Republic.** Perez, E. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

This presentation shows how solar electric technology may help alleviate severe electricity shortages in the Dominican Republic. Graphs show how the deficit in supply and demand of electricity and the losses in energy distribution in the Dominican Republic have both increased from 1980 to 1990. The energy losses have increased from 27.2 in 1980 to 31.5 in 1990 with a decrease in energy production from 1988 to 1990.

**33863** (SERI/CP–250-4254-Vol.2, pp. 279-302) **Opportunities for solar thermal electric technology in Nevada.** McKinney-James, R. (Nevada Public Service Commission, Carson City (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

After five months, three hearings, two expert panel exchanges, and two consumer sessions, the Nevada Public Service Commission unanimously adopted a new rule designed to recognize and quantify environmental externalities. The rule sets forth a mechanism for the commission to provide reference to those sources of electricity which are kindest to the environment while providing some direct economic benefit to the state of Nevada. This rule opens the door to the introduction of solar power as a viable and competitive participant in the electric resource mix of Nevada electric utilities. It may well expand the use of geothermal electricity generation and the exploration of wind power in the state. The promulgation of this regulation came as a result of state legislation which became effective in October 1989. This measure required the commission to establish a preference to those sources of electricity generation which provide the greatest economic and environmental benefits to the state. LUZ International recognized as the nation's leading solar company is presently in negotiations with Nevada Power Company to construct a 120 megawatt facility in southern Nevada. The climate for the use of solar in Nevada is very positive from both the political and regulatory perspective. However, many questions will need to be answered before the commission can fully embrace solar as an electric generation option. One will need to determine the extent to which the use of a natural gas back-up will increase the cost to ratepayers; the extent to which the use of natural gas may increase rather than decrease environmental damage impacts on land use, e.g., the desert tortoise and, the impact on water use. The future of the water supply in fast growing southern Nevada is probably the public policy issue for the 1990's.

## 1408 Ocean Energy Systems

*Refer also to citation(s) 34241*

**33864** (ANL/CP–72704) **Production of desalinated water using ocean thermal energy.** Rabas, T.; Panchal, C. Argonne National Lab., IL (United States). [1991]. 8p. Sponsored by

USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9110218–1: Oceans '91, Honolulu, HI (United States), 1-3 Oct 1991). Order Number DE91018894. Source: OSTI; NTIS; GPO Dep.

This paper describes an Ocean Thermal Energy Conversion (OTEC) desalination plant that consists of a multistage flash evaporator (MSF), a closed-cycle OTEC power plant, and an appropriate seawater system depending if the desalination plant is land based or floating. OTEC desalination plants of this type are preferred because the production of desalinated water far exceeds that obtained from other OTEC plant types employing the same size seawater system. The focus of the paper is on the multistage flash evaporator. The similarities and differences between conventional MSF and OTEC multistage flash evaporators (OTEC-MSF) are first described. Then the details of the OTEC-MSF evaporator design are discussed and preliminary correlations are recommended for the three major elements: the flash chamber, the moisture removal device, and the condenser. Recent advances such as enhanced condenser tubes, condensers of the compact type, and corrugated-plate moisture separators are introduced into the design. Comparisons of the water production capability, evaporator shell volume, and material cost are then presented for state-of-the-art and the new design concepts. 20 refs., 11 figs., 5 tabs.

**33865** (DOE/CH/10093–100/1991) **Ocean energy contract list, fiscal year 1990.** Solar Energy Research Inst., Golden, CO (United States). Aug 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. Order Number DE91002177. Source: OSTI; NTIS; GPO Dep.

The purpose of the federal Ocean Energy Technology (OET) Program is to develop techniques that harness ocean energy (waves, currents, and thermal and salinity gradients) in a cost-effective and environmentally acceptable manner. The OET Program seeks to develop ocean energy technology to a point at which the commercial sector can assess whether applications of the technology are viable energy conversion alternatives or supplements to systems. The federal OET Program is conducted by DOE and is assigned to the Assistant Secretary for Conservation and Renewable Energy. Past studies conducted by the US Department of Energy (DOE) have identified ocean thermal energy conversion (OTEC) as the largest potential contributor to US energy supplies from the ocean resource. As a result, of the OET Program concentrates on research to advance OTEC technology. The FY 1990 contract overview comprises a list of all subcontracts begun, ongoing, or completed during FY 1990 (October 1, 1989, through September 30, 1990). Under each managing laboratory, projects are listed alphabetically by project area and then by subcontractor name.

## 1409 Solar Thermal Utilization

*Refer also to citation(s) 33604, 33904, 34241, 34318, 34373, 35066*

**33866** (DOE/SF/16308–T2) **Advanced phase change materials and systems for solar passive heating and cooling of residential buildings: Final technical report, May 29, 1986–July 15, 1988.** Salyer, I.O.; Sircar, A.K.; Dantiki, S. Dayton Univ., OH (United States). Research Inst. [1988]. 523p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86SF16308. Order Number DE92000400. Source: OSTI; NTIS; GPO Dep.

During the last three years under the sponsorship of the DOE Solar Passive Division, the University of Dayton Research Institute (UDRI) has investigated four phase change material (PCM) systems for utility in thermal energy storage for solar passive heating and cooling applications. From this research on the basis of cost, performance, containment, and environmental acceptability, we have selected as our current and most promising series of candidate phase change materials, C-15 to C-24 linear crystalline alkyl hydrocarbons. The major part of the research during this contract period was directed toward the following three objectives. Find, test, and develop low-cost effective phase change materials (PCM) that melt and freeze sharply in the comfort temperature range of 73–77°F for use in solar passive heating and cooling of buildings. Define practical materials and processes for fire retarding plasterboard/PCM building products. Develop cost-effective methods for incorporating PCM into building construction materials (concrete, plasterboard, etc.) which will lead to the commercial manufacture and sale of PCM-containing products resulting in significant energy conservation.

**33867** (ENEA-RTI-FARE–90-18) **Uncoverd-collector, solar water heater for swimming pool showers.** Bertocchi, A.; Caselli, G.; Maccari, A. ENEA, Casaccia (Italy). Dipt. Fonti Alternative e Risparmio Energetico. 1990. 23p. (In Italian). (RTI-FARE–90-18). Order Number DE92705863. Source: OSTI; NTIS (US Sales Only).

The solar water heater, designed for use in climates such as that found on the Adriatic coastline, makes use of a single, or direct pass system (thus eliminating any need for storage tanks and thermostatic valves) to satisfy typical requirements such as 2,000 liters/day of 24-27 degrees C minimum/35 degrees maximum hot water for showers. This supply can be met by a 6.3 square meter, polypropylene collector surface area to heat 15 degree, network fed water. The basis of the system's design and its main performance characteristics, simulated and prototype, are outlined in this paper.

**33868** (ENET–8900168/3) **Solar communal housing at Preverenges: Report on technical installations: heating systems, ventilation, domestic hot water.** Zakher, A. (Ingenieurs-conseils SA, Lausanne (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Oct 1990. 50p. (In French). Order Number DE92714218. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

The Swiss Department for Federal Construction held a competition in 1982 for a residential estate in the Preverenges community. The aim was quoted as being: - The reduction of the maximum energy requirements, - Use of effective systems for the production and use of heat, - Passive use of solar energy and the possibility of using solar panels for providing hot water. The report describes the technical installations for heating, ventilation and hot water and indicates the possibilities of improvement. figs., tabs., 5 refs.

**33869** (ENET–8900168/4) **Energy analysis of solar communal housing.** Eggimann, J.P. (Ecole Polytechnique Federale, Laboratoire d'Energie Solaire et de Physique du Batiment, Lausanne (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Oct 1990. 116p. (In French). Order Number DE92714221. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

The energetical behaviour of the solar energy multi-family housing estate in Preverenges was followed by means of measuring instruments over a long period. It was possible to create an exact energy balance. As far as the requirements for heating energy are concerned these buildings are among the best in Switzerland. On the other hand their general electricity consumption as well as that for providing hot water is by no means below the Swiss average. Parameter studies were carried out which allowed the influence of various factors to be simulated by computer and thus making it possible to find different buildings with minimum energy requirements. The parameter studies also showed how important the behaviour of the inhabitants is in relation to the performance of the verandas. figs., tabs., 37 refs.

**33870** (ENET–8900170/1) **Calculation of energy requirements for a building using experimental matrices. Final report.** Gay, J.B. (Ecole Polytechnique Federale, Lab. d'Energie Solaire et de Physique du Batiment, Lausanne (CH)); Meris, M. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Sep 1990. 109p. (In French). Order Number DE92714223. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

The aim of this report is to show that the scientific experiment planning can be applied to building physics, to present their methods and their theoretical principles, to show the various possible steps using a practical example and to provide the interested reader with the necessary principles for the application in building physics. 68 figs., 59 tabs., 8 refs.

**33871** (ETDE-mf–2704498) **Use of solar energy in the open-air pool Neukirchen/Knuellgebirge 1. Preliminary study.** WZ III-Arbeitsberichte. Kuehne, R. Kassel Univ. (Gesamthochschule) (Germany). Wissenschaftliches Zentrum

Mensch-Umwelt-Technik (WZ III). May 1989 13p. (In German). Order Number DE92704498. Source: OSTI; NTIS (US Sales Only).

With the letter dated 08.11.1988 the science center (WZ) III has through arrangement of the Technologie and Innovationsberatung taken on the preparation of a preliminary study for solar thermal energy use in the open-air pool Neukirchen. Within the framework of this report the energetic and monetary effects of an investment decision on the construction and operation of a solar collector system for the open-air pool Neukirchen are determined. Against the background of the fact that the open-air pool Neukirchen is at present operated without pool water heating particularly the quality of comfort improvement (higher water temperature) and the incurring costs are subject of this study. (orig./UA).

**33872** (ETDE-mf–2704578) **Technical use of solar energy. Project 'Photovoltaic systems'. Final report.** Herrmann, B.; Honstetter, K.; Karl, H.; Kopf, E.; Lehner, G. Stuttgart Univ. (Germany). Inst. fuer Theorie der Elektrotechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Dec 1989 198p. (In German). Contract BMFT 03E8020B. Order Number DE92704578. Source: OSTI; NTIS (US Sales Only).

The following report deals with the development and the measurements of photovoltaic waterpumping devices, the development of small seale cooling device with latent storage, models for the systems with and without a battery storage, optimization for the investigated devices. (orig.) With 120 refs., 5 tabs., 109 figs.

**33873** (NEI-DK–645) **Modular system for solar walls. Part 1: Technological and economical analysis. Final report.** Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark); KHR A/S, Virum (Denmark); Hansens (H.S.) Fabrikker A/S, Lem (Denmark). Mar 1991 84p. (In Danish). Contract TR-89.0605. Order Number DE92703898. Source: OSTI; NTIS (US Sales Only).

The overall aim of the project was to develope a system of modules for renovating buildings for commercial production. Included in the system were unventilated and ventilated solar wall - insulation - window - and glass covered balcony modules. Architectural aspects were considered to be important as well as ecomomical, technological and commercial ones. It was also thought to be vital that the use of these products would contribute to the saving of energy. The results of the investigation of potentials in this respect and the recommended design are presented in detail. (AB) 18 refs.

**33874** (NEI-DK–649) **Use of thermography for service inspection of solar heating systems: A practical guide to thermographic methods.** Clausen, I.-L.; Perch-Nielsen, T. Dansk Teknologisk Inst., Taastrup (Denmark). Proevestationen for Solenergi. Apr 1991 23p. (In Danish). Contract ENS-UVE-90.0017. Order Number DE92703901. Source: OSTI; NTIS (US Sales Only).

A thermographic camera registers heat radiation from a surface or body. A thermogram from a solar collector shows the temperature distribution on the absorber. Where the solar collector has a glass covering the absolute temperature will not be seen, but the heat that is transferred from the absorber to the covering will be registered. However heat radiation will be registered through a plastic covering. A thermographic camera will be able to show areas on the absorber which are either hotter or colder than is to be expected, it will also reveal poor insulation in tube joints and valves, faults in installation, in valve adjustment and control defects in addition to cracks in the covering layer of the solar collector. Practical guidance in the use of a thermographic camera in relation to in-service inspection of solar heating systems is presented. (AB).

**33875** (SERI/CP–250-4254-Vol.1, pp. 3-11) **Overview of the solar industrial program.** Wilkins, F. (Dept. of Energy, Washington, DC (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

The Solar Industrial Program was formed to help establish solar energy as an option for the industrial sector. This coincides to a time when increasing national concern over energy and the environment offers an opportunity for early markets of solar energy. Establishment of an industrial market will increase the solar industry's production base and help reduce costs. This will benefit solar technology not only for industrial use, but also for residential, commercial and utility applications. It will thus accelerate the time when clean, domestically available solar energy becomes a major alternative to fossil fuels in the US. There are three elements of the Program: detoxification of hazardous chemicals, process heat, and advanced industrial processes.

**33876** (SERI/CP–250-4254-Vol.1, pp. 13-31) **Solar Detoxification Program.** Anderson, J. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

This presentation addresses the uses of photocatalysis in the detoxification of water and solids (low Btu wastes, soils, used carbon, etc.) using two solar processes. The first is an ambient temperature process, the second a high temperature (>700C) process. There are current applications and research projects discussed. This presentation consists of overheads only.

**33877** (SERI/CP–250-4254-Vol.1, pp. 33-52) **Solar Process Heat Program.** Hewett, R. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

The Solar Process Heat Program has been established to work with the solar industry and actual and potential endusers to remove barriers. The goal of the program is to help attain significant solar market penetration in economically-viable application/market combinations. The program is organized into four tasks: Task 1: Solar Heat Applications Market Assessments; Task 2: Collaborative Projects with and Technical Support to the Solar Industry; Task 3: Technical Assistance, Technology Transfer, Outreach and Other Support for Actual and Potential Endusers; and Task 4: Solar Process RDT and D in Support of Industry's Commercialization Activities. Planned accomplishments for calendar year 1991 include: (1) initiation of several prefeasibility studies to assess the merits of utilizing the technology in specific applications in specific organizations; (2) establishment of several cooperative projects with industry; (3) development of promotional materials for use in marketing and educational programs; (4) completion of some targeted educational/familiarization programs; and (5) establishment and documentation of the financial analysis methods and decision criteria utilized by representative potential endusers in evaluating process heat equipment.

**33878** (SERI/CP–250-4254-Vol.1, pp. 53-73) **SERI's Advanced Industrial Processes Project.** Carasso, M. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

SERI's Advanced Industrial Processes Project aims at moving to industrial commercialization materials manufacturing and processing methods which have been demonstrated to be technically feasible and have commercial merit, as well as at conducting ongoing collaborative R and D in innovative industrial processes using concentrated solar energy. The project consists of three elements: high flux optics, materials processing, and advanced systems and economic studies.

**33879** (SERI/CP–250-4254-Vol.1, pp. 75-92) **SERI Solar Industrial Applications Assistance Project.** Hewett, R. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

SERI Solar Industrial Applications Assistance Project (SIAAP) technical assistance activities make use of existing SERI facilities

such as the SERI Solar Detoxification Test Facility, the High Flux Solar Furnace and the Concentrator Research Laboratory. General activities in FY1991 include: providing direct, hands-on ad hoc technical and systems analysis assistance to industry, etc.; education potential endusers, policymakers and regulatory agencies; serving as a focus for collecting and disseminating information and reports about the solar technologies for specific applications; participating in the exhibition and technical programs of the annual conferences of professional/trade associations of the target audiences; and providing feedback to the Solar Industrial Program for use in program planning.

**33880** (SERI/CP–250-4254-Vol.1, pp. 93-111) **Solar thermal electric technology - Status and thrust.** Scheve, M. (Dept. of Energy, Washington, DC (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

This paper supports solar thermal electric technology energy cost and performance projections for the National Energy Strategy. This paper reviews the basic principles of solar thermal electric and energy conversion, and the previous contributions of the National Solar Thermal Systems Programs. It discusses the market status for solar thermal electric technology, and identifies user requirements to help establish the future technology path and the historical role of the solar thermal electric industry. It projects trends in the performance and cost of the technology based on input from national laboratories and industry experts.

**33881** (SERI/CP–250-4254-Vol.1, pp. 113-129) **Commercial application activities: Department of Energy Solar Thermal Electric Program.** Klimas, P.C. (Sandia National Lab., Albuquerque, NM (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. DOE Contract AC04-76DP00789. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

The Department of Energy Solar Thermal Electric Program has shifted its emphasis from research and development to a commercial applications-driven set of cooperative activities with significant industrial involvement in both planning and execution. The purpose of this shift is to accelerate the commercialization of solar thermal electric technology. By closely linking the program to private sector needs, specific activities will support early market penetration of the technology, and program resources will be more highly leveraged. Government/industry partnerships will produce teams uniquely qualified to accomplish this. The partnerships will combine the manufacturing, marketing, and management skills of industry with the solar-specific experience base and analytical and experimental capabilities of the laboratories. Under this scenario, the program is divided into two main categories: Commercial Applications and Technology Development. Commercial Applications activities determine the overall direction of the program. Technology Development efforts in the concentrator and power conversion tasks support the Commercial Applications task. Relative to earlier years, technology development focuses on nearer timeframes, and far-term research plays a reduced, but continuing, role. The presentation by R.B. Diver in this volume describes this program element. Following is a brief description of the program's Commercial Applications efforts.

**33882** (SERI/CP–250-4254-Vol.1, pp. 131-149) **Solar Thermal Electric Program - Power conversion technology development.** Diver, R.B. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

Solar Thermal Electric Technology has made significant progress over the past 15 years. Central receiver technology was successfully demonstrated at the Solar One power plant where during the last year of power production over 95% availability was demonstrated. The world's record for solar-to-electric conversion efficiency is currently held by the Advanco parabolic dish-Stirling system. Over 350 megawatts of generating capacity from LUZ International parabolic trough systems is operational today in California. The near-term evolution of these technologies holds great promise for pandemic application of solar thermal electric systems.

**33883** (SERI/CP–250-4254-Vol.1, pp. 169-183) **The Solar Thermal Design Assistance Center - An overview of its successful technology transfer efforts.** Menicucci, D. (Sandia National Lab., Albuquerque, NM (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. DOE Contract AC04-76DP00789. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

The Solar Thermal Design Assistance Center at Sandia National Laboratories is a resource provided by the US Department of Energy's Solar Thermal Program. Its major objectives are to accelerate the use of solar thermal systems through cooperative efforts with private industry, technology transfer activities, and direct technical assistance. The Solar Thermal Design Assistance Center recently published a brochure outlining its operation. The text of this brochure exemplifies the tech-transfer publications the center distributes and outlines its activities. It is included here as a preview of the conference presentation. The conference presentation describes the center's activities in more detail. The structure and operation of the center are outlined, and examples are presented to show the type of assistance and services that are provided. The presentation at this conference features some of the most successful projects of recent years and discusses the center's plans for the future.

**33884** (SERI/CP–250-4254-Vol.1, pp. 187-201) **Changing directions: New proposed DOE thrusts.** Carwile, C. (Dept. of Energy, Washington, DC (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

The results discussed here are from the initial study on the potential of solar process heat in the industrial sector, completed in November, 1990. The primary conclusion is that there is a significant potential for solar industrial process heat (IPH) - as much as 5 Quads of thermal energy out of a projected total of 12.6 Quads for manufacturing activities alone in the industrial sector. But improvements in technology, or rather reductions in the cost of energy (even beyond that estimated for the United Solar installation at Tehachapi), will be required for significant penetration to occur by the year 2030. Otherwise, the penetration model predicts early introduction in niche markets, some growth, and finally a roll off. Hopefully, one learns from experience, but not the wrong things, and can structure an appropriate role for DOE in solar IPH. In looking for Quads, the name of the game is parabolic troughs and dishes. Troughs are here and now for low and medium temperature process heat, but the higher temperature applications will require further development of dishes and receivers. For dishes, the author depends on the Solar Thermal Electric Program to continue and meet its planned developmental schedules. Other types of solar thermal technology such as flat plate collectors and concentration parabolic collectors also have a role in industrial process heat.

**33885** (SERI/CP–250-4254-Vol.1, pp. 203-211) **What is needed from DOE's Solar Heat Program - An industry perspective.** De Laquil, P. (Bechtel Group, Inc., San Francisco, CA (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

The Department of Energy is now in a position to structure a new program which could stimulate and support significant growth in the solar process heat market. The US consumes about 15% of its primary energy to deliver industrial process heat, and a large fraction

of this potential market is in the temperature range achievable using today's solar thermal technology. However, over the 1980's, solar thermal technologies were not able to make any significant penetration of this market due to: (1) the economic climate of low fuel prices, (2) the insensitivity of the energy market, as well as the financial community, to the social and environmental benefits of solar energy sources, (3) the societal emphasis on short-term profits, in which solar energy technologies having a high capital cost (with very low annual costs) are not as financially attractive as low capital cost technologies (even those with high, or highly uncertain, annual costs), (4) declining federal R and D support which has delayed many possible improvements in the technologies, and (5) continued government subsidies to conventional energy sources. Growing environmental concerns, especially at the local level, renewed interest in energy security, and emerging mechanisms to introduce environmental benefits into the market place are creating the opening for a reemergency of the solar process heat industry. The three categories of activities which DOE can and should support to stimulate this budding US solar process heat industry are (1) Regional Market Assessments, (2) Market Impact Analyses, and (3) Funded Research. This presentation addresses these areas.

**33886** (SERI/CP–250-4254-Vol.1, pp. 227-249) **Isaac™ solar absorption icemaker.** Erickson, D.C. (Energy Concepts Co., Annapolis, MD (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference. Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

This paper describes the application of ammonia absorption cycle type solar icemaker technology specifically developed for remote locations off the electric grid. Discussed are the design features of the solar collector, absorber cooling at night, auxiliary heating coil for cloudy days, economics of scale, ease of manufacture and applications to current needs.

**33887** (SERI/CP–250-4254-Vol.1, pp. 251-287) **Solar heat applications in California: Status and prospects.** Kulkarni, P. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

The presentation reviews the current status of industrial, commercial and institutional solar heat applications in California. It analyzes recent projects and assess their impact on commercialization of the solar heat technologies in California. The presentation assesses the emerging opportunities and discusses factors affecting growth over the next five years. The public policy objectives regarding energy in the state and their potential impacts on solar heat applications are discussed. The presentation reviews the current programs and projects undertaken by the California Energy Commission to encourage solar applications in the industrial, commercial and institutional sectors.

**33888** (SERI/CP–250-4254-Vol.1, pp. 289-305) **Gould's solar industrial process heat system - An update on its performance and plans for upgrade.** Knipfer, D. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

This presentation outlines this project in detail starting with a brief history of the plant and its early successes. Operational problems are outlined, especially those involving flexhoses. A description of the three-phase program developed by Gould and Sandia is discussed in detail including some of the data collected to date. Time lines are presented that show the progress on phase 1 and the plans for phase 2. The presentation concludes with some thoughts about the benefits of this cooperative effort to Gould as well as to the national solar program. Specifically, the benefits and critical aspects of Sandia's technical assistance will be described.

**33889** (SERI/CP–250-4254-Vol.1, pp. 307-315) **Stretched membrane parabolic trough system for process hot water/ planned solar air conditioning system.** Bronstein, A. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

This presentation describes Sunsteam, Incorporated's retrofit of a stretched membrane covering for parabolic trough collectors for process hot water heating. The retrofit results in increased efficiency for the solar plant. A planned demonstration of a solar absorption air conditioning system is also discussed which does not use chlorofluorocarbons.

**33890** (SERI/CP–250-4254-Vol.1, pp. 319-321) **Solar heat applications: Products and national/international market opportunities.** Sheinkopf, K.G. (Solar Energy Industries Association, Washington, DC (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

You've just seen several examples of current and near-term solar industrial applications - including large commercial systems, new applications, new technologies, and new ways of using the various solar heat products. The author summarizes this morning's session by giving a look at the state-of-the-art of solar heat applications - where we are today, and where we're going to be in the very near future. Today we're still in the midst of worldwide concern about the environment and the hazards of burning fossil fuels, and only now beginning to feel the long-term effects of the recent Persian Gulf war and the environmental problems and long-term worry over the security of our oil supplies. For those who are only now beginning to learn about solar industrial applications, the message is very simple - solar energy is a proven, reliable energy source with hundreds of uses in commercial buildings and industrial applications of all kinds. From low temperature uses like heating for commercial swimming pools to medium-temperature systems for heating water for buildings to high temperature systems that produce electricity. Solar energy is economical, cost-effective, and proven reliable. Thanks to the efforts of government and industry, there are now many sources of assistance to help design, build, operate and maintain these systems. A number of publications, services and materials have been developed to help avoid the mistakes of the past and build systems that perform as needed. There are a number of guides, directories, and on-going publications from the Solar Energy Industries Association, the ASHRAM-sponsored books on design, O and M, and installation, the SERI solar building assistance and the Sandia Design Assistance Center, and other Department of Energy-sponsored programs and services help building owners, government officials, and others learn how to use the technology to save energy and money.

**33891** (SERI/CP–250-4254-Vol.2, pp. 3-17) **Solar Water Detoxification Program review.** Anderson, J. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

This presentation described progress in commercialization of two solar detoxification processes. One process at ambient temperature treats wastewater, groundwater and drinking water; the other process at high temperature (>700C) treats low Btu wastes, soils, used carbon, etc. Both use a photocatalytic process. Current and future applications are described.

**33892** (SERI/CP–250-4254-Vol.2, pp. 35-50) **Preliminary design of a solar detoxification field experiment.** Laxson, A.S. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings.*

*Volume 2.* 317p. Order Number DE91013767. Source: OSTI: NTIS.

Photocatalytic destruction of organic compounds in contaminated water driven by solar radiation is being developed into a large-scale field experiment by a consortium of three federal laboratories: the Solar Energy Research Institute, Sandia National Laboratories, and Lawrence Livermore National Laboratory. The field experiment has four major experimental objectives: advancement of the technology into a nonlaboratory waste remediation environment; development of operational procedures; compilation of test data to help guide laboratory research and future demonstrations; and development and testing of plant control strategies. This presentation describes the preliminary design.

**33893** (SERI/CP–250-4254-Vol.2, pp. 51-63) **Conceptual design study for a solar detoxification system for the DOE Rocky Flats facility in Colorado.** Kelly, B. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

Sandia National Laboratories, in cooperation with the Solar Energy Research Institute (SERI), have contracted with Bechtel Corporation for the conceptual design and permitting plan of a demonstration solar detoxification project. The objectives of the study are to assess the following: the cost and schedule of a demonstration program for DOE planning purposes; and the economic potential of future commercial facilities. The site selected for the study is the Rocky Flats Plant in Colorado, and the design groundwater flow rate is 0.0063 $m^3$/sec (100 gpm). A pretreatment system modifies the groundwater chemistry in three areas to ensure complete decomposition of the toxic compounds. The first two requirements, as specified by SERI, include adjustment of the pH to a nominal value of 6 and addition of hydrogen peroxide ($H_2O_2$) and oxygen ($O_2$). The third requirement is the decomposition of calcium bicarbonate ($Ca(HCO_3)_2$) to prevent scale formation on the catalyst. This report describes the design and operation of the system.

**33894** (SERI/CP–250-4254-Vol.2, pp. 65-73) **Solar water treatment system concepts and economics.** Link, H.; Turchi, C.S. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

Laboratory and small-scale field experiments have shown that concentrated solar flux can be used to detoxify water contaminated with a variety of hazardous chemicals. By directing the ultraviolet portion of sunlight onto a catalyst immersed in contaminated water, solar detoxification systems break down toxic organic chemicals into nontoxic compounds such as carbon dioxide ($CO_2$), water ($H_2O$), and dilute hydrochloric acid (HCl). Additionally, solar water detoxification contains environmental benefits compared to other treatment technologies, notably low power consumption and on-site contaminant destruction. The Solar Energy Research Institute (SERI) and Sandia National Laboratories are heading the US Department of Energy efforts to develop solar detoxification technology for commercial application. This presentation describes the treatment system for Lawrence Livermore National Laboratory.

**33895** (SERI/CP–250-4254-Vol.2, pp. 75-99) **Market evaluation of solar detoxification technology for aqueous waste streams.** Bahm, M. (Radian Corp., Milwaukee, WI (USA)); Osantowski, R.A. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

The Solar Energy Research Institute (SERI) of Golden Colorado has demonstrated the use of solar energy for the detoxification of contaminated aqueous waste streams. SERI contracted Radian Corporation to conduct a technical and market evaluation of the technology to help provide direction to the development program, and to identify potential applications for the process. This presentation is a preliminary summary of this work. For the technical evaluation, Radian gathered all available technical information from SERI, and obtained technical input from SERI and Sandia personnel. Identification of market niches was based on information gathered from a review of technical databases, the technical literature, the knowledge and experience of Radian personnel, and personal contacts in the waste treatment and general environmental field. The attributes of the technology were compared with market needs to identify opportunities for, and barriers to, market entry. Factors that were evaluated include the quantities and geographic distribution of potential treatment streams; the identification of sites where potential candidate waste streams treatable by this technology can be found; the logistics of applying the technology to waste locations or vice versa; the characteristics of the waste relative to the capabilities of the technology; and the non-technical, but significant, issues of regulatory implications and public perceptions.

**33896** (SERI/CP–250-4254-Vol.2, pp. 101-111) **Recent results and implications of large-scale solar detoxification of water experiments at Sandia National Laboratories.** Pacheco, J. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. DOE Contract AC04-76DP00789. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

Sandia National Laboratories' part in the Department of Energy's Solar Detoxification of Hazardous Waste Initiative is focused on conducting large-scale solar photocatalytic experiments. Sandia's efforts support fundamental laboratory research performed by the Solar Energy Research Institute (SERI), which will lead to the first field experiment of the technology at Lawrence Livermore National Laboratory by around July 1991. In Sandia's facility which consists of six parabolic troughs in series, water, spiked with a contaminant, flows through glass pipe reactors centered at the focus of the troughs. The ultraviolet portion of the concentrated sunlight activates a titanium dioxide catalyst to form oxidizers which have the ability to decompose many organic compounds. The process has two broad applications: remediation of groundwater and treatment of industrial effluents. Sandia's work represents the first attempt to extend the process to a practical scale. They have conducted numerous tests with water contaminated with dilute concentrations (100 to 10,000 parts per billion) of chlorinated solvents (e.g., trichloroethylene (TCE), trichloroethane (TCA), perchloroethylene (PCE), and methylene chloride), salicylic acid, and textile dyes using a large parabolic trough. Recent results from these experiments and the implications to system configurations and to the practicality of the process will be discussed.

**33897** (SERI/CP–250-4254-Vol.2, pp. 113-132) **Solar detoxification of contaminated water: The design and fabrication of a prototype low-cost concentrator system.** May, K.; Gee, R. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

Industrial Solar Technology, under contract to the Solar Energy Research Institute, is starting projects to design and fabricate a prototype, low-cost concentrator system to be used to detoxify contaminated water. The projects have two major elements: the first aimed at developing a concentrator that can be installed at a cost of \$50/$m^2$; the second to produce a fixed bed reactor with equivalent or better performance than reactors using a slurry of titanium dioxide. This presentation reports on current status and future work.

**33898** (SERI/CP–250-4254-Vol.2, pp. 133-148) **Solar detoxification of water: Laboratory research.** Blake, D.M. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

The destruction of hazardous organic chemical contaminants in water by photocatalytic oxidation over semiconductors is the subject of worldwide interest. This paper reviews the laboratory research project being carried out by the US Department of Energy to develop a unit operation for water decontamination using solar energy as the light source. This part of the program includes in-house research at the Solar Energy Research Institute and Sandia National Laboratories, subcontracted work at universities, collaborative work with industry, and the tracking of progress of other research groups in laboratories throughout the world.

**33899** (SERI/TP–250-4474) **Solar detoxification technology: Using energy from the sun to destroy hazardous waste.** Anderson, J.V.; Clyne, R.J. Solar Energy Research Inst., Golden, CO (United States). Aug 1991. 8p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); Environmental Protection Agency, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-9109255–1: Challenge of the environment: new technologies, Restono, VA (United States), 5-6 Sep 1991). Order Number DE91015007. Source: OSTI: NTIS; GPO Dep.

Solar energy is being applied to one of the most difficult environmental problems our country faces in the coming decades: the destruction of hazardous waste. DOE Researchers are developing two separate technologies – solar detoxification of water and solar decontamination of soil – that could revolutionize the way toxic wastes are removed from the environment. Unlike many remediation techniques in use today, these solar-based processes actually destroy hazardous contaminants; the wastes are not transferred to other media for disposal. Solar detoxification of water uses solar energy to power a reaction that eliminates organic contaminants from polluted surface water and groundwater. The process uses a solar-activated photocatalyst, such as titanium dioxide, to break the bonds holding organic compounds together. Researchers are currently working to increase the efficiency and reduce the costs of the process to make it economically competitive with traditional remediation methods. In a related program researchers are investigating the ability of high solar flux (upwards of 300 times the sun's normal intensity) to decontaminate polluted solids such as soils. The solar decontamination of soil is a two-step process: in the first step contaminants are desorbed from the solid either by solar thermal energy or by conventional means (such as heating or vacuum extraction); in the second step the desorbed contaminants are destroyed. The contaminants can be destroyed by using either a high-flux photolytic process or a low-flux process that employs a photocatalyst. SERI's state-of-the-art high-flux solar furnace is home to a large portion of the soil decontamination research. 4 figs.

## 1410 Solar Collectors and Concentrators

**33900** (SAND–91-7001) **Photovoltaic concentrator module improvements study.** Levy, S.L. (Black and Veatch, Kansas City, MO (United States)); Kerschen, K.A.; Hutchison, G.; Nowlan, M.J. Sandia National Labs., Albuquerque, NM (United States). Aug 1991. 145p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE92000605. Source: OSTI; NTIS; GPO Dep.

This report presents results of a project to design and fabricate an improved photovoltaic concentrator module. Using previous work as a baseline, this study conducted analyses and testing to select major module components and design features. The lens parquet and concentrator solar cell were selected from the highest performing, available components. A single 185X point-focus module was fabricated by the project team and tested at Sandia. Major module characteristics include a 6 by 4 compression-molded acrylic lens parquet (0.737 $m^2$ area), twenty-four 0.2 ohms-cm, FZ, p-Si solar cells (1.56 $cm^2$ area) soldered to ceramic substrates and copper heat spreaders, and an aluminized steel housing with corrugated bottom. This project marked the first attempt to use prismatic covers on solar cells in a high-concentration, point-focus application. Cells with 15 percent metallization were obtained, but problems with the fabrication and placement of prismatic covers on these cells lead to the decision not to use covers in the prototype module. Cell assembly fabrication, module fabrication, and module optical design activities are presented here. Test results are also presented for bare cells, cell assemblies, and module. At operating conditions of 981 watts/$m^2$ DNI and an estimated cell temperature of 65°C, the module demonstrated an efficiency of 13.9 percent prior to stressed environmental exposure. 12 refs., 56 figs., 7 tabs.

**33901** (SAND–91-7007) **Design of the support structure, drive pedestal, and controls for a solar concentrator.** Goldberg, V.R. (WG Associates, Dallas, TX (United States)); Ford, J.L.; Anderson, A.E. Sandia National Labs., Albuquerque, NM (United States); WG Associates, Dallas, TX (United States). Aug 1991. 114p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE92000604. Source: OSTI; NTIS; GPO Dep.

The glass/metal McDonnell-Douglas dish is the state-of-the-art of parabolic dish concentrators. Because of the perceived high production cost of this concentrator, the Department of Energy's Solar Thermal Program is developing stretch-membrane technology for large (75 kWt) solar concentrators for integration with receivers and engines in 25 kWe dish-Stirling systems. The objective of this development effort is to reduce the cost of the concentrator while maintaining the high levels of performance characteristic of glass-metal dishes. Under contract to Sandia National Laboratories, Science Applications International Corporation, Solar Kinetics Inc. and WG Associates are developing a faceted stretched-membrane heliostat technology. This design will result in a low-risk, near-term concentrator for dish-Stirling systems. WG Associates has designed the support structure, drives and tracking controls for this dish. The structure is configured to support 12 stretched-membrane, 3.5-meter diameter facets in a shaped dish configuration. The dish design is sized to power a dish-Stirling system capable of producing 25 kW (electric). In the design of the structure, trade-off studies were conducted to determine the "best" facet arrangement, dish contour, dish focal length, tracking control and walk-off protection. As part of the design, in-depth analyses were performed to evaluate pointing accuracy, compliance with AISC steel design codes, and the economics of fabrication and installation. Detailed fabrication and installation drawings were produced, and initial production cost estimates for the dish were developed. These issues, and the final dish design, are presented in this report. 7 refs., 33 figs., 18 tabs.

**33902** (SERI/CP–250-4254-Vol.1, pp. 151-167) **The DOE Solar Thermal Electric Program Concentrator Technology Project.** Mancini, T.R. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

The Department of Energy's Solar Thermal Program Concentrator Technology Project comprises the development of concentrating solar collectors, heliostats and dishes, and the development of optical materials. Because the solar concentrator represents from 40 to 60% of the cost of a solar thermal electric system, the continued development of high-performance concentrators that cost less than current heliostats and dishes is very important to the commercial viability of these systems. Heliostats are long-focal-length concentrators used in central receiver power systems to reflect the sun's energy onto a centrally located receiver. The receiver absorbs the thermal energy that is then used in a conventional power plant cycle to generate electrical power. Glass heliostat technology is commercially viable today. The Concentrator Technology Project is currently testing two large area heliostats, the SPECO 200 $m^2$ heliostat and the ATS 150 $m^2$ heliostat. The project is also trying to reduce the cost of the heliostats through the development of stretched-membrane heliostats. Stretched-membrane heliostats are made by attaching thin metal membranes to the two sides of a circular, metal ring. A slight vacuum in the plenum between the two membranes is used to focus the heliostat. The optical surface is provided by a silver-acrylic film, ECP 305. The measured performance of prototype stretched-membrane heliostats is comparable to the glass heliostats and, because of their utilization of fewer, less expensive materials, the potential cost of stretched-membrane heliostats is substantially less than the glass heliostats. A prototype

100 $m^2$ commercial unit has been built and is currently being tested.

**33903** (SERI/CP–250-4254-Vol.1, pp. 213-226) **Applications of parabolic trough technology.** May, K.; Gee, R. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

This article describes the application of parabolic trough technology in the design and operation of the Industrial Solar Technology Corporation's large scale systems for industrial and commercial applications. Described is the design of the collector, the control system, fabrication and construction, and three installations of this technology in commercial systems.

**33904** (SERI/CP–250-4254-Vol.1, pp. 317) **Low and medium flat plate technology for industrial process heating.** Brooks, A. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.1: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 1.* 312p. Order Number DE91002163. Source: OSTI; NTIS.

For many years when one mentioned Industrial Process Heating (IPH) only trough and parabolic collectors have been thought of. Today attitudes are changing and with good reason. While the low and medium Flat Plate industries experienced considerable growth in the early 1980s it was considered that the business came from individual residents. While this was by and large true it wasn't until after the residential slow down that many people began to see other applications that were installed and working well with little to no maintenance. These applications were in fact industrial process heat application. These applications did not require 600 degree temperatures or even 300 degree temperatures. In many cases they required only 80 degree temperatures. It has been long thought of that the high temperature technology should be totally separate from medium and low temperature technology. However, the most successful applications are those that have been properly matched to the technology. This means one doesn't need a 600 degree parabolic collector to heat a fish farm nor would one use a flat plate to power a turbine. By blending the technologies together it will allow and justify full time sales and maintenance groups causing positive cash flow. The high temperature technology has complained that unless the system is more than 30,000 square feet that there isn't justification for maintenance people. A suggestion to the industry is that the technologies work closer together forming IPH sales groups which are trained in all technologies and are focused on IPH applications. This would create more applications, constant cash flow and allow for full time roving maintenance people justifying smaller systems. The following are some industry applications for low and medium temperature IPH: hotels, motels, fish farms, alligator farms, commercial laundries, laundromats, car washes, plating companies, food processors, military barracks, college dormitories, and prisons.

## 1420 Heat Storage

**33905** (ENET–8900031/2) **Solar energy: seasonal storage: Specialist conference, Bern, 18-19 October 1989.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 106p. (In DE,FR). Order Number DE92714229. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

The following subjects in connection with the seasonal storage of solar energy were dealt with at this specialist conference: problems of short-term and long-term storage, the Swiss project within the scope of Task VII of the IEA Solar Energy Programme, results of readings taken at the solar installation in Vaulruz, the store in an industrial building in Meyrin-Geneva, the zero-energy house in Oberburg, a project in Sierre, Swedish and German experiences. Moreover, the planning principles and a guide to the seasonal storage of heat were also presented.

**33906** (ENET–8900437/1) **Chemistry and microbiology in the field of energy storage in an aquifer. Report on phase I: International Energy Agency Annex VI Programme.** Miserez, J.J. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 112p. (In French). Order Number DE92714230. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

This report gives a compilation of the results of Phase 1 of the IEA Annex VI Programme. An important role in this programme is played by SPEOS (= stockage pilote d'energie par ouvrage souterrain), an experimental storage installation in Dorigny at Lausanne. Phase 1 of the programme contains the following parts: a) simulation of the biochemical mass transportation, b) in vitro-study of the biochemical reactions at increased temperatures, c) effect of the surroundings on the storage system and the procedure to reduce the silting-up of the groundwater and installations, d) microbiological aspects in the area of hygiene and supporting the development of corrosion-metal precipitation, e) development of techniques to prevent corrosion and silting-up. 49 figs., 1 tab., refs.

**33907** (ENET–8900437/2) **Chemistry and microbiology in the field of energy storage in an aquifer. Report on phase I, annexes: volume I: Programme Annex VI of the International Energy Agency.** Miserez, J.J. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 314p. (In French). Order Number DE92714231. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

This report contains information on the work in the field of microbiology and computer simulation which was carried out within the framework of the IEA Annex VI-Programme. figs., tabs., refs.

**33908** (ENET–8900437/3) **Chemistry and microbiology in the field of energy storage in an aquifer. Report on phase I, annexes: volume II: Programme Annex VI of the International Energy Agency.** Miserez, J.J. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 255p. (In French). Order Number DE92714232. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

This report contains information on the work in the field of microbiology and computer simulation which was carried out within the framework of the IEA Annex VI-Programme. figs., tabs., refs.

## 1430 Health and Safety

**33909** (KFA-STE-IB–1/90) **Environmental impact statements using photovoltaism as an example. Interim report.** Hirtz, W.; Huber, W. Forschungszentrum Juelich GmbH (Germany). Programmgruppe Systemforschung und Technologische Entwicklung. Jun 1990. 80p. (In German). Order Number DE92714337. Source: OSTI; NTIS (US Sales Only).

The project 'Environmental Impact Statements', which has been carried out under commission to the BMFT since the beginning of 1990, aims at developing a test procedure to ensure that the human and environmental consequences of a projected technical development from research are taken into consideration. The project sponsors should thereby be placed in the position of deciding whether suitable studies need to be carried out, which of the various environmental aspects are to be considered relevant to the project and should be incorporated into the agreement to the project in the form of objectives or criteria. The procedure should enable the necessity for and content and depth of the studies to be established. (orig.).

# 15 GEOTHERMAL ENERGY

## 1501 Resources and Availability

*Refer also to citation(s) 33913*

## 1502 Geology and Hydrology of Geothermal Systems

**33910** (LBL–29400) **TOUGH2: A general-purpose numerical simulator for multiphase fluid and heat flow.** Pruess, K.

Lawrence Berkeley Lab., CA (United States). May 1991. 102p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000755. Source: OSTI; NTIS; GPO Dep.

TOUGH2 is a numerical simulation program for nonisothermal flows of multicomponent, multiphase fluids in porous and fractured media. The chief applications for which TOUGH2 is designed are in geothermal reservoir engineering, nuclear waste disposal, and unsaturated zone hydrology. A successor to the TOUGH program, TOUGH2 offers added capabilities and user features, including the flexibility to handle different fluid mixtures, facilities for processing of geometric data (computational grids), and an internal version control system to ensure referenceability of code applications. This report includes a detailed description of governing equations, program architecture, and user features. Enhancements in data inputs relative to TOUGH are described, and a number of sample problems are given to illustrate code applications. 46 refs., 29 figs., 12 tabs.

**33911** (SAND–91-1694C) **Numerical simulation of magma energy extraction.** Hickox, C.E. Sandia National Labs., Albuquerque, NM (United States). [1991]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9110214–1: US/Japan joint seminar on heat transfer, Oiso (Japan), 21-25 Oct 1991). Order Number DE91019063. Source: OSTI; NTIS; GPO Dep.

The Magma Energy Program is a speculative endeavor regarding practical utility of electrical power production from the thermal energy which reside in magma. The systematic investigation has identified an number of research areas which have application to the utilization of magma energy and to the field of geothermal energy. Eight topics were identified which involve thermal processes and which are areas for the application of the techniques of numerical simulation. These areas are: (1) two-phase flow of the working fluid in the wellbore, (2) thermodynamic cycles for the production of electrical power, (3) optimization of the entire system, (4) solidification and fracturing of the magma caused by the energy extraction process, (5) heat transfer and fluid flow within an open, direct-contact, heat-exchanger, (6) thermal convection in the overlying geothermal region, (7) thermal convection within the magma body, and (8) induced natural convection near the thermal energy extraction device. Modeling issues have been identified which will require systematic investigation in order to develop the most appropriate strategies for numerical simulation. It appears that numerical simulations will be of ever increasing importance to the study of geothermal processes as the size and complexity of the systems of interest increase. It is anticipated that, in the future, greater emphasis will be placed on the numerical simulation of large-scale, three-dimensional, transient, mixed convection in viscous flows and porous media. Increased computational capabilities, e.g.; massively parallel computers, will allow for the detailed study of specific processes in fractured media, non-Darcy effects in porous media, and non-Newtonian effects. 23 refs., 13 figs., 1 tab.

## 1503 Geothermal Exploration and Exploration Technology

**33912** (ETDE-mf–2714356) **Proceedings of the 20th session of FKPE working group 'Determination of the temperature distribution in the earth crust', 1990.** Buntebarth, G. (ed.). Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany). Inst. fuer Geophysik. 27 Feb 1991 122p. (In German). Order Number DE92714356. Source: OSTI; NTIS (US Sales Only).

The lectures report temperature observations from drilling studies which are to contribute to the determination of the surface heat flow density, the hydraulic properties of underground structures, and the geothermal energy potential. The strong influence of Alpine genesis on the temperature distribution inside the Alpine crust is pointed out. Results of the measurements in the Weiden and Roethenbach sites are compared with the KTB measurements. Thermally relevant rock parameters of the underground structures are determined by conductivity fluid logging. (DG).

## 1505 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 34241*

**33913** (DOE/EIA–0544) **Geothermal energy in the western United States and Hawaii: Resources and projected electricity generation supplies.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. Sep 1991. 70p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000614. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

Geothermal energy comes from the internal heat of the Earth, and has been continuously exploited for the production of electricity in the United States since 1960. Currently, geothermal power is one of the ready-to-use baseload electricity generating technologies that is competing in the western United States with fossil fuel, nuclear and hydroelectric generation technologies to provide utilities and their customers with a reliable and economic source of electric power. Furthermore, the development of domestic geothermal resources, as an alternative to fossil fuel combustion technologies, has a number of associated environmental benefits. This report serves two functions. First, it provides a description of geothermal technology and a progress report on the commercial status of geothermal electric power generation. Second, it addresses the question of how much electricity might be competitively produced from the geothermal resource base. 19 figs., 15 tabs.

## 1508 Geothermal Power Plants

*Refer also to citation(s) 33861, 33913*

## 1509 Geothermal Engineering

**33914** (PNL–7794) **Particle measurement and brine chemistry at the Salton Sea Deep Well.** Robertus, R.J.; Kindle, C.H.; Sullivan, R.G.; Shannon, D.W. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000031. Source: OSTI; NTIS; GPO Dep.

The Advanced Brine Chemistry Project, a part of the US Department of Energy's Geothermal Energy Program, is addressing operating problems associated with scaling and corrosion at geothermal power plants. Under this project, Pacific Northwest Laboratory conducted a series of tests at the Salton Sea Deep Well, which has one of the highest solids contents in the world. The purpose of the tests was to evaluate monitoring instrumentation under field conditions and relate particulate formation to the brine chemistry. The instrumentation, was evaluated under scaling geothermal conditions using two different principles: ultrasonic reflection and laser light scattering. The following conclusions were drawn from the instrumentation testing and brine chemistry and particulate analyses. (1) Using reflected ultrasonic impulses to detect suspended particles has been demonstrate for on-line application in a geothermal brine with strong scaling tendencies. Advantages over laser light scattering include improved high-temperature durability for the transducer and longer operation with less maintenance. (2) Counting and sizing particles using laser light scattering requires constant maintenance in geothermal applications. (3) Silica is the dominant scale species and appears in amounts orders of magnitude greater than other minor species such as barium sulfate. (4) The silica that formed at high temperatures and short residence times is very gelatinous and difficult to filter out of the brine. (5) Correlation of instrument readings with particle collection data was difficult because conditions on the filter (i.e., temperature, flowrate, and pressure) could not be maintained constant for long enough intervals to obtain comparable information. 5 refs., 27 figs., 2 tabs.

## 1510 Direct Energy Utilization

**33915** (TYOT-JULK–318) **Soil heating in connection with outdoor garden production.** Malkki, S.; Moilanen, J. Tyotehoseuran Julkaisuja, Helsinki (Finland). 1991. 126p. (In Finnish). Order Number DE92704001. Source: OSTI; NTIS (US Sales Only).

Soil heating using electricity, hot water and air has been studied within Nordic countries as a way to extend the growing season in

spring. The methods have not found general acceptance in practical outdoor garden production in Nordic countries, except in Iceland. The main reason for this may be the fairly high investment costs, lack of know-how, and the above-normal risks both at the cultivation stage and in marketing of the harvest. Two thirds of the respondents (177 persons) were prepared to accept the soil heating on outdoor garden production by electrical cables if it is profitable. Only one fifth of the respondents thought that it would be wasting of natural resources, and that plant protection by chemicals should be cut down in the future or to keep their use at the present level. The respondents believed that more efforts should be made in marketing of the garden products by improving the product quality, purity and aroma, because these are the most important sales promotion factors. Two thirds thought that the Finnish garden production sector would retain it's present status or improve it in the future. Organic farming and greening were believed to possess the best prerequisites for surviving the increasingly tough competition of the non-restricted European markets. Under-glass cultivation and fruit orchards in Finland were believed to run into difficulties.

### 1520 Geothermal Data and Theory

**33916** (DOE/ER/14080–2) **Development of an experimental database and theories for prediction of thermodynamic properties of aqueous electrolytes and nonelectrolytes of geochemical significance at supercritical temperatures and pressures: Annual Progress.** Wood, R.H. Delaware Univ., Newark, DE (United States). Dept. of Chemistry and Biochemistry. 2 May 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14080. Order Number DE91018493. Source: OSTI; NTIS; GPO Dep.

Volumetric measurements have been completed for $CH_4$, $CO_2$, and $H_2S$ at temperatures from 25°C to 380°C and 2 or 3 pressures at each temperature. The $H_2S$ and $CO_2$ solutions are stored in aluminized mylar bags in PVC pipes with water surrounding the bags at a pressure of several atmospheres. The methane is stored in a one liter autoclave with a sliding teflon piston engaging the sides of the autoclave which separates the standard methane solution from the pressurizing fluid. The solutions are prepared at 100 to 200 atmospheres and do not need to be re-standardized after each experiment. We also have some measurements on aqueous ammonia, boric acid, and acetic acid. Preliminary calculations of the free energy of methane in water at room temperature as a function of the model parameters for the methane have been finished. In preparation for these calculations, the theory and practice of the free energy perturbation calculations was reviewed. In molecular dynamics and Monte Carlo calculations a system does not immediately equilibrate to a change in the Hamiltonian, so that there is a time lag or a configuration number lag in the response of the system. These lags cause errors in free energy calculations. 4 refs.

## 16 TIDAL AND WAVE POWER

### 1604 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 33865*

## 17 WIND ENERGY

**33917** (ENET–8900332/1) **The use of wind energy in the Canton of Bern. Final report.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Dec 1990. 50p. (In German). Order Number DE92714224. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

In 1987 the Director for Transport, Energy and Water in the Canton of Bern started the project 'Potential of wind energy in the Canton of Bern'. The project proceeded in three phases: in the first stage the foundation was formed, in the second stage wind measurements were taken at 26 locations and in the third stage the results were evaluated. This report summarises the results of Phases 1 and 2 and presents the figures for the potential of wind energy in the Canton of Bern. This amounts to approx. 100'000 MWh with a kWh-price of 50 Rp., which corresponds to 1.8% of the electricity requirements of the Canton. 11 figs., 11 tabs., 4 refs.

### 1701 Resources and Availability (Climatology)

**33918** (PNL–7789) **An assessment of the available windy land area and wind energy potential in the contiguous United States.** Elliott, D.L.; Wendell, L.L.; Gower, G.L. Pacific Northwest Lab., Richland, WA (United States). Aug 1991. 92p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018887. Source: OSTI; NTIS; GPO Dep.

Estimates of land areas with various levels of wind energy resource and resultant wind energy potential have been developed for each state in the contiguous United States. The estimates are based on published wind resource data and account for the exclusion of some windy lands as a result of environmental and land-use considerations. Despite these exclusions, the amount of wind resource estimated over the contiguous United States is surprisingly large and has the potential to supply a substantial fraction of the nation's energy needs, even with the use of today's wind turbine technology. Although this study shows that, after exclusions, only about 0.6% of the land area in the contiguous United States is characterized by high wind resource (comparable to that found in windy areas of California where wind energy is being cost-effectively developed), the wind electric potential that could be extracted with today's technology from these areas across the United States is equivalent to about 20% of the current US electric consumption. Future advances in wind turbine technology will further enhance the potential of wind energy. As advances in turbine technology allow areas of moderate wind resource to be developed, more than a tenfold increase in the wind energy potential is possible. These areas, which cover large sections of the Great Plains and are widely distributed throughout many other sections of the country, have the potential of producing more than three times the nation's current electric consumption. 9 refs., 12 figs., 13 tabs.

**33919** (RISO-M–2879) **Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.** Lundsager, P.; Harvoee, P. (eds.). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. 349p. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

These proceedings contain the papers presented at the UNDTCD Conference held August 1989 at Risoe National Laboratory, Denmark. The papers include national overviews including a number of Third World nations as well as technical papers on a range of topics. A "listeners report" from the closing plenary session is included. (author) 27 tabs., 94 ills., 79 refs.

**33920** (RISO-M–2879, pp. 26) **Wind assessment for project evaluation.** Larsen, S.E. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. SOMALIA/energy policy; WIND POWER; SOMALIA; RISOE NATIONAL LABORATORY; RURAL AREAS; ELECTRIC POWER; EVALUATION; SITE SELECTION

### 1703 Legislation and Regulations

*Refer also to citation(s) 33940, 33941*

### 1704 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 33938, 33945, 33946, 33948, 33949, 33961, 34241*

**33921** (NEI-DK–630) **A study tour: Concerning Japanese energy technology - 20/11 to 7[1]2 1990.** Madsen, B.T. BTM-Consult I/S, Skjern (Denmark). 1991 52p. (In Danish). Contract

ENS-UVE-90.0199. Order Number DE92703868. Source: OSTI; NTIS (US Sales Only).

The general aim was to promote industrial cooperation between Japan and the European Communities. The more specific aim was to obtain an overview of the current status of Japanese wind technology. The author visited 15 private concerns in Honzu and Kyushu and a number of research institutes in Tokyo. He felt that research and development within the field of energy in general and renewable energy in particular is given high priority in Japan but that results are generally not put into practice in that country. Japan is more interested, the author claims, in taking advantage of the developing market in other countries for renewable energy technologies. Information gathered and conclusions reached by the author in the process of this study tour are presented. (AB).

**33922** (NEI-DK–633) **Wind power in the 90's: Pure energy.** Foreningen af Danske Vindmoellefabrikanter, Herning (Denmark). [1991] 19p. Contract ENS-UVE-90.0040. Order Number DE92703873. Source: OSTI; NTIS (US Sales Only).

The status, historical background and future prospects of wind energy in Denmark are described. Furthermore, the quality approval of wind turbines, the electric supply system, windfarms, economy, environmental impacts and exports are dealt with. A list of useful addresses within the Danish wind industry are included. (CLS).

**33923** (RISO-M–2879, pp. 52-65) **Grid integration of Danish wind turbines.** Nielsen, P. (DEFU, Lyngby (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

The rapid growth of wind turbines being connected to the Danish electricity supply system has provided insight into many problems of linking wind turbines to electric utility systems. The Danish electricity supply system, accounting rules for wind power generation, grid-connection to wind turbines, a power integration study and a wind-diesel project are described with special emphasis on how to handle surplus power. (CLS).

**33924** (RISO-M–2879, pp. 81-116) **Wind energy activities in Iraq.** Al-Alawy, I.T. (Scientific Research Council, Solar Energy Research Centre, Baghdad (IQ)); Al-Hamdani, N.I. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

The basic indicators of wind potential for selected sites in different geographical locations throughout the country for a period 1971-1985 are investigated. It was shown that the annual average wind power densities ranged between 26.82-36.5 watt/$m^2$ could be found in Iraq. Among these sites Ana and Amara seem to be the sites with highest wind potential ranged between 65.1-81.6 watt/$m^2$ respectively. It could be reaches slightly more or less than one Kw/$m^2$ at Busaiya and Sulman. Wind map of Iraq through a period 1941-1985 shows that the average wind speed in Iraq at 10 meter altitude is falls between 2.5-4 m/sec. It can be seen that 25% of the country enjoys monthly wind speed greater than 4 m/sec. Therefore wind energy is sufficient for water pumping or electricity (using hybrid system) supply for remote areas in Iraq. A computer program has been developed to carry out a full statistical analysis which involved hourly wind speed, monthly average speed, annual values of shape and scale paramters of Normal and Weibull distribution. Frequency distribution, relative frequency, wind speed duration, speed distribution, with their individual and cumulative probability pattern, capacity factor and energy pattern factor, are analyzed. The mesurement showed that wind could be a good potential source of energy in certain locations. This fact may be of significant importance in remote areas where fuel transportation is difficult and the development of such area is a national aim. (CLS) 10 refs.

**33925** (RISO-M–2879, pp. 119-121) **Wind/diesel and stand alone options.** Lundsager, P. (The Test Station for Wind Turbines, Risoe (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 390p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

The demand for electricity is an increasingly important issue in developing countries. At locations where supply systems already exist, energy supply may be seriously limited by extremely high fuel prices and/or limited availability of fuel. Also, the fuel used in the generation of electricity has to be paid for by a part of the trading ability of the country, that could otherwise have been used by the country in a direct trading relationship with other countries. Therefore, a very important aspect of wind power in developing countries is the fuel saving. For remote rural locations a number of options exist for the electricity supply by wind turbines either in connection with local diesel power plants (wind/diesel systems) or independently (stand-alone systems). The specific options available in any given case depend on the choice of components, which again may depend on local conditions or requirements, and the number of options may seem very large indeed. Data available for choice of system configuration and determination of system specifications are often scarce, and therefore computer models used for prediction of fuel savings should be flexible and easy to use. Finally, decision makers should use socioeconomic criteria rather than purely economic ones when evaluating wind/diesel or stand alone systems. (author).

**33926** (RISO-M–2879, pp. 147-153) **Wind energy in Pakistan.** Bashar, M.J. (Ministry of Planning and Development, Government of Pakistan, Islamabad (PK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Pakistan's experience of wind energy is very limited and of recent duration. However, the energy shortage and the wide geographical dispersal of its rural population offers considerable potential for harnessing the wind. Whatever technology is introduced, it must conform to local wind characteristics and other conditions and must be accompanied by appropriate management, operation, servicing and maintenance arrangements. The tendency otherwise is to unfairly condemn the technology itself. (author).

**33927** (RISO-M–2879, pp. 180-202) **Wind energy status and experiences from the USA.** Sherwin, R.W. Jr. (Atlantic Orient Corporation, North Norwich, Vermont (US)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

The last ten years has seen a significant use in wind power throughout the world. Worldwide sales in 1975 of wind electric equipment was less than 3 or 4 million dollars. These companies provide almost all of the equipment; Winco (U.S.), Elektro (Switzerland), and Dunlite (Australia). The last two are not longer making wind turbines. Current worldwide investment is approximately 3.5 to 4.0 billion of this approximately 2.5 - 3.0 billion is installed in the United States, with most of it being located in California. Most of the remaining investment is in Europe although significant investments are now being made in India and China. While in the late 1970's and early 1980's most manufacturing activity was taking place in the U.S., by 1985 Europe, especially Denmark, Britain, and the Netherlands were beginning to make significant inroads into the U.S. and world market. Denmark also has a large domestic market. (author).

**33928** (RISO-M–2879, pp. 203-204) **Experience from pilot and demonstration wind energy project.** Hansen, J.C. (Wind Engineering Section, Department of Meteorology and Wind Energy, Risoe National Laboratory, Roskilde (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. DEVELOPING COUNTRIES/wind power; WIND POWER/demonstration programs; DIESEL ENGINES; RISOE NATIONAL LABORATORY

**33929** (RISO-M–2879, pp. 230-236) **Prospects of co-production: An example: Egyptian wind turbine manufacture for local windfarms.** Petersen, H. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

For two reasons is it reasonable to describe the programme in Egypt on local manufacture of wind turbines for windfarms in Egypt, - the conditions for application of wind energy in Egypt are very good, the wind speeds in certain areas are excellent and the need for large scale electricity generation is strong, - manufacture of wind turbines in the country itself is important for the economy of the windfarms and for the employment of local people. The manufacture is established by technology transfer from experienced foreign companies to Egyptian companies and the governmental authorities by financial support from UNDP, United Nations Development Programme. (author).

**33930** (RISO-M–2879, pp. 237-240) **Co-production of commercialized grid connected wind turbines.** Andersen, N. (Vestas Wind Systems A/S (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

This paper describes the development of the Danish wind turbine producer's, VESTAS Wind Systems A/S, wind turbines, and direct transfer of technology aimed at co-production. (CLS).

**33931** (RISO-M–2879, pp. 257-260) **Wind energy in Yugoslavia.** Lazarecic, M. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

A preliminary estimation of the wind energy potential in Yugoslavia and the technological development of using wind turbines for electricity production is presented. (CLS).

**33932** (RISO-M–2879, pp. 344-345) **DANIDA prospects on wind energy.** Soerensen, C. (DANIDA (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. DEVELOPING COUNTRIES/technology transfer; TECHNOLOGY TRANSFER/wind turbines; DENMARK

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*Refer also to citation(s) 33920, 33922, 33924, 33927, 33929, 33931, 34272*

**33933** (RISO-M–2879, pp. 19-25) **Wind resource assessment.** Lundtang Petersen, E. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Concepts for assesing wind energy resources over a large area and for the prediction of the average yearly energy production are presented. These are based on the production of experience gained from the production of the European Wind Atlas. (AB).

**33934** (RISO-M–2879, pp. 27-42) **On application of wind energy in Jordan.** Anani, A. (Renewable Energy Dept., Amman (JO)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Jordan has a relatively significent experience with application of renewable energy systems. This paper dwells on Jordan's experience in utilizing wind energy for power generation and water pumping. (author).

**33935** (RISO-M–2879, pp. 43-47) **Wind energy related activities in Turkey.** Uyar, T.S. (Scientific and Technical Research Council of Turkey, Marmara Scientific and Industrial Research Institute, Mechanical and Energy Engineering Department, Gebze Kocaeli (Turkey)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Wind energy related activities in Turkey are described. (CLS) 17 refs.

**33936** (RISO-M–2879, pp. 48-49) **Wind energy technology grid connected wind turbine.** Rasmussen, F. (The Test Station for Windmills, Risoe (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. DENMARK/wind turbines; DENMARK; ROTORS; POWER SYSTEMS

**33937** (RISO-M–2879, pp. 50-51) **Utility considerations in application of wind energy.** Hasted, F. (ELKRAFT, Information Department (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. WIND TURBINES/research programs; DENMARK; ELECTRIC POWER INDUSTRY

**33938** (RISO-M–2879, pp. 66-76) **The industrial development of wind energy utilization in Denmark.** Madsen, B.T. (T.C. Consulting, Skjern (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. DENMARK/wind power; DENMARK; WIND TURBINES; TECHNOLOGY IMPACTS

**33939** (RISO-M–2879, pp. 77-78) **Wind energy research and development in Denmark.** Hauge Madsen, P. (The Test Station for Windmills, Risoe (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. DENMARK/wind power; DENMARK; RISOE NATIONAL LABORATORY; RESEARCH PROGRAMS; DESIGN; AERODYNAMICS

**33940** (RISO-M–2879, pp. 79-80) **Certification.** Hjuler Jensen, P. (The Test Station for Windmills, Risoe (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy.* 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. WIND TURBINES/certification; CERTIFICATION; DENMARK

**33941** (RISO-M–2879, pp. 117-118) **Wind turbine testing.** Friis Pedersen, T. (The Test Station for Windmills, Risoe (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. WIND TURBINES/denmark; WIND TURBINES/testing; DENMARK; TESTING; RISOE NATIONAL LABORATORY

**33942** (RISO-M–2879, pp. 122-136) **Small stand-alone systems.** Fraenkel, P.L. (I.T. Power Ltd., Eversley, Hants (GB)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

The main purpose of this paper is to review opportunities for the use of windpower in remote areas where there is no electricity grid, which of course is a common feature of the rural areas of many of the poorer developing countries. It should also be mentioned that similar situations arise in the remoter areas of some of the larger and richer developed countreis such as the USA, Australia, the USSR and even parts of Western Europe. Hence, generally speaking the wind systems appropriate in the remoter parts of the developing countries are equally applicable in the remoter parts of the industrialised countries generally for similar purposes. Therefore, this paper will deal exclusively with small stand-alone wind power systems and will also highlight one or two significant factors of special importance for the use of the technology in developing countries, such as the potential importance of local manufacture of equipment. In virtually all cases, stand-alone systems are single-end-use dedicated systems where a wind-turbine performs one purpose, although some development of wind-diesel systems is taking place with the objective of producing an electrical output which seeks to provide the same kind of multi-application supply as a grid connection so as to allow a variety of electrical appliances to be connected and used independently and sometimes simultaneously. It is however intended to focus primarily on the two main kinds of wind stand-alone systems which are actually in widespread practical use, namely mechanical windpumps and small wind-electricity generators for battery charging. (author).

**33943** (RISO-M–2879, pp. 137-138) **Status for the Danish windpump development.** Voelund, P. (The Test Station for Wind Turbines, Risoe (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Short communication. WIND-POWERED PUMPS/horizontal axis turbines; DENMARK

**33944** (RISO-M–2879, pp. 139-146) **Some aspects of the utilization of wind energy in the Socialist Republic of Romania.** Toma, E. (Research Institute for Electrical Engineering Bucharest (RO)); Olar, L. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Romania is a country situated in a geographical zone with a strong interference of air masses and with big thermobaric contrasts, the wind energy potential being generally good. Studies on the distribution of wind speeds were carried out along multiannual periods in approximately 80 meteorological stations and succeeded to determine 5 zones which are represented as regions with average annual energy densities measured in $kWh/m^2.yr$. The zones give a general picture of the available wind potential which amounts for the whole country to $12x10^6$-$15x10^6$ MWh/yr. Due to the climatic and morphologie diversity of the territory, was created a large range of wind equipment going from low (0.2 kW) up to high powers (300 kW). Six systems utilizing the wind energy are based on Romanian produced turbines and have been introduced in current use: 1 kW for water pumping (TS-1); 4 kW for water pumping (TS-4OP); 6 kW for electical energy production (TEV-6); 20 kW for electrical energy production (TEV-20); 1,3 kW for electrical energy production (TEO-2-0); 4 kW for water pumping (TS-4-OE). Details about 13 wind turbines developed in Romania are presented including technical characteristics. (author).

**33945** (RISO-M–2879, pp. 154-168) **Utilisation of wind energy in Sri Lanka.** Ruban, H.K. (Wind Energy Unit, Water Resources Board (LK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

This paper briefly summarises the history of utilisation of wind energy in Sri Lanka, its wind energy resources and the attempts of utilising wind power in the country. (author).

**33946** (RISO-M–2879, pp. 169-175) **Wind energy utilization in Mauritius.** Soonarane, P.M.K. (Ministry of Energy, Water Resources and Postal Services (MU)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

This paper outlines the various activities in Mauritius in connection with wind energy utilization. A number of developments have taken place in this context on the main island of Mauritius as well as on the smaller outlying island of Rodrigues. (author).

**33947** (RISO-M–2879, pp. 177-179) **Wind energy policies and applications in Denmark.** Lemming, J. (Danish Energy Agency, Copenhagen (DK)); Secher, F. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. DENMARK/wind power; ENERGY POLICY/wind power; DENMARK; WIND TURBINES

**33948** (RISO-M–2879, pp. 205) **Wind farm projects.** Jensen, S.A. (COWIconsult, Consulting Engineers and Planners (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. DEVELOPING COUNTRIES/wind turbine arrays; WIND TURBINE ARRAYS/implementation; IMPLEMENTATION

**33949** (RISO-M–2879, pp. 206-207) **Wind/diesel projects.** Lundsager, P. (The Test Station for Wind Turbines, Risoe (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. DENMARK/wind turbines; WIND TURBINES/diesel engines; DENMARK; DEMONSTRATION PROGRAMS; RISOE NATIONAL LABORATORY; DEVELOPING COUNTRIES

**33950** (RISO-M–2879, pp. 208-209) **Wind/diesel control experience.** Christensen, B. (BC-Engineering, Birkeroed (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. WIND TURBINES/diesel engines: OPERATION: CAPE VERDE ISLANDS; CHINA

**33951** (RISO-M–2879, pp. 210-212) **Development and application of small scale wind turbines.** Karottki, R. (Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (DK)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. PUMPS/wind turbines; WIND-POWERED PUMPS; PUMPS; TECHNOLOGY IMPACTS; RURAL AREAS

**33952** (RISO-M–2879, pp. 213-228) **Perspective of wind energy in the Syrian Arab Republic.** Kordab, M. (Renewable Energies Office in the Prime Minister's Council (SY)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Multiplade windmills are used in Syria for pumping subterranian water for agricultural and domestic purposes in different areas, since the second half of 19th century. Wind energy is considered as one of the renewable energies resources which Syria has to setilise them for generating electrical energy to which demand is continuously increasing as a result of progress and population growth. Utilization of wind energy requires detailed information on wind energy in the perspective areas. The climatic statistical information available in the Meteorological Department has been used in the wind ATLAS, and typographic information according to a limited scientific methodology for differentiation between the various mountains, and according to mathematical and physical models used for excluding the surface wind speeds and wind speed on different heights as well as for identification of roughness co-efficient which differ from one areas to another. (AB).

**33953** (RISO-M–2879, pp. 229) **The use of wind energy at Easter Island.** Roth Urban, P. (Satgo (CL)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. CHILE/wind power; SOLAR ENERGY; CHILE

**33954** (RISO-M–2879, pp. 241-247) **Comparative evaluation of technical and economic performance of water pumping windmills.** Oostendorp, P.A. (Consultancy Services Wind Energy Developing Countries, University of Twente (NL)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

This paper gives an overview of activities by CWD (Consultancy Service Wind Energy Developing Countries) in the field of comparative evaluation of water pumping windmills. First an introduction is given to the "Handbook for Comparative Evaluation of Technical and Economic Performance of Water Pumping Systems". In the handbook standardized and uniform procedures are given in order to enable comparative evaluations of six selected water pumping techniques which are: grid connected electric pumps, fuel engine pumps, solar pumps, wind pumps, hand pumps, and animal traction pumps. Secondly the paper describes shortly the comparative testing of water pumping windmills at the CWD test fiels in Almere. (CLS).

**33955** (RISO-M–2879, pp. 248-255) **Wind energy for developing countries: promise and problems.** Lovejov, D. (United Nations Department of Technical Co-operation for Development (US)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Global wind energi is not evenly distributed, especially in the case of the developing countries which have generally poor winds. The site specifications for California and the Guls of Suez are described. Furhtermore, offshore siting and environmental considerations are dealt with. (CLS).

**33956** (RISO-M–2879, pp. 261-280) **The use of wind energy in Brasil.** Hirata, M.H. (Laboratorio de Mecanica dos Fluidos-Aerodinamica, PEM-COPPE/UFRJ, Rio de Janeiro (BR)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

The main objective of this paper is to provide a brief introductory survey of the wind energy in Brazil. A description of the wind in the country which enables one to identify some regions with a good wind regime is presented. For two of these promissing regions some complementary data about the wind distribution are available; these are the northeast and the south regions of the country. The second part of the paper deals with the use of wind energy in Brazil. An introduction to the generation and distribution of electricity is made and a conclusion that the generation of electricity for rural areas is the most promissing application of the wind energy. The energy for rural areas would be used mainly for irrigation purposes in order to substitute for the existing diesel pumps; of course with the introduction of wind energy for irrigation the agriculture frontier would expand, not only in the traditionally productive regions, but also in the midwest region which is characterized for having a good soil but not so much rain. (CLS).

**33957** (RISO-M–2879, pp. 281-290) **The use of wind energy in Jamaica.** Lawson, A. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

This paper presents the early and recent systems of wind turbines on Jamaica, the types of wind turbines, wind mapping, proposed use of wind energy for power generation and W.E.C.S. (Wind Energy Conversion Systems) for water pumping. (CLS).

**33958** (RISO-M–2879, pp. 291-295) **The wind energy experience of H.C.R. in water pumping and electricity production.** Semmar, M. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. ALGERIA/wind turbines; ALGERIA

**33959** (RISO-M–2879, pp. 296-326) **Wind speeds in Zimbabwe.** Marawanyika, G. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

The paper presents data on the wind speeds in Zimbabwe, in the form of tables, figures and maps, and the history and present status of the windmill technology of today, especially wind pumps. (CLS).

**33960** (RISO-M–2879, pp. 327-335) **Wind energy development and application in China.** Yang Xiaosheng. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Wind energy utilization has a long history in the world. China was one of the earliest countries which using wind power as energy. And since 1977, when China began the policies of economic reform and openning to the outside world, wind energy utilization has got a rapid development in China. (author).

**33961** (RISO-M–2879, pp. 336-340) **Country paper - Mongolia.** Jamtsai, B. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

The Government of the Mongolian People's Republic has set and is implementing a task to provide in general the herdsmen suuris with the sources of electricity during forthcoming 8-10 years. Herdsmen suuri is a primary productive unit which forms the basis of the country's livestock industry and consists of 2-4 families living in one place. (author).

**33962** (RISO-M–2879, pp. 341-343) **Wind power in Uruguay.** Olague, M. (National Energy Department, Ministry of Industry and Energy (UY)). Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Jan 1991. (CONF-8908286–: International workshop on wind energy, Roskilde (Denmark), 21-25 Aug 1989). In *Proceedings of UNDTCD/Danida/Risoe international workshop on wind energy*. 349p. Order Number DE92703790. Source: OSTI; NTIS (US Sales Only).

Abstract only. URUGUAY/wind power; URUGUAY

**33963** (SAND–91-1124) **Numerical simulation of VAWT stochastic aerodynamic loads produced by atmospheric turbauence: VAWT-SAL code.** Homicz, G.F. Sandia National Labs., Albuquerque, NM (United States). Sep 1991. 73p. Sponsored by USDOE. Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE92000597. Source: OSTI; NTIS; GPO Dep.

Blade fatigue life is an important element in determining the economic viability of the Vertical-Axis Wind Turbine (VAWT). A principal source of blade fatigue is thought to be the stochastic (i.e., random) aerodynamic loads created by atmospheric turbulence. This report describes the theoretical background of the VAWT Stochastic Aerodynamic Loads (VAWT-SAL) computer code, whose purpose is to numerically simulate these random loads, given the rotor geometry, operating conditions, and assumed turbulence properties. A Double-Multiple-Stream Tube (DMST) analysis is employed to model the rotor's aerodynamic response. The analysis includes the effects of Reynolds number variations, different airfoil sections and chord lengths along the blade span, and an empirical model for dynamic stall effects. The mean ambient wind is assumed to have a shear profile which is described by either a power law or a logarithmic variation with height above ground. Superimposed on this is a full 3-D field of turbulence: i.e., in addition to random fluctuations in time, the turbulence is allowed to vary randomly in planes perpendicular to the mean wind. The influence of flow retardation on the convection of turbulence through the turbine is also modeled. Calculations are presented for the VAWT 34-m Test Bed currently in operation at Bushland, Texas. Predicted time histories of the loads, as well as their Fourier spectra, are presented and discussed. Particular emphasis is placed on the differences between so-called "steady-state" (mean wind only) predictions, and those produced with turbulence present. Somewhat surprisingly, turbulence is found to be capable of either increasing or decreasing the average output power, depending on the turbine's tip-speed ratio. A heuristic explanation for such behavior is postulated, and a simple formula is derived for predicting the magnitude of this effect without the need for a full stochastic simulation. 41 refs., 32 figs., 1 tab.

**33964** (SERI/TP–257-4123) **A PC-based telemetry system for acquiring and reducing data from multiple PCM streams.** Simms, D.A.; Butterfield, C.P. Solar Energy Research Inst., Golden, CO (United States). Jul 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CH10093. (CONF-911187–1: International telemetering conference, Las Vegas, NV (United States), 4 Nov 1991). Order Number DE91002199. Source: OSTI; NTIS; GPO Dep.

The Solar Energy Research Institute's (SERI) Wind Research Program is using Pulse Code Modulation (PCM) telemetry data-acquisition systems to study horizontal-axis wind turbines. Many PCM systems are combined for use in test installations that require accurate measurements from a variety of different locations. SERI has found them ideal for data-acquisition from multiple wind turbines and meteorological towers in wind parks. A major problem has been in providing the capability to quickly combine and examine incoming data from multiple PCM sources in the field. To solve this problem, SERI has developed a low-cost PC-based PCM telemetry data-reduction system to facilitate quick, in-the-field multiple-channel data analysis. Called the "PC-PCM System," it consists of two basic components. First, PC-compatible hardware boards are used to decode and combine multiple PCM data streams. Up to four hardware boards can be installed in a single PC, which provides the capability to combine data from four PCM streams directly to PC disk or memory. Each stream can have up to 62 data channels. Second, a software package written for use under DOS was developed to simplify data-acquisition control and management. The software provides a quick, easy-to-use interface between the PC and multiple PCM data streams. Called the "Quick-Look Data Management Program," it is a comprehensive menu-driven package used to organize, acquire, process, and display information from incoming PCM data streams. The paper describes both hardware and software aspects of the SERI PC-PCM system, concentrating on features that make it useful in an experiment test environment to quickly examine and verify incoming data from multiple PCM streams. Also discussed are problems and techniques associated with PC-based telemetry data-acquisition, processing, and real-time display. 11 refs., 2 figs., 3 tabs.

# 20 FOSSIL-FUELED POWER PLANTS

## 2001 Power Plants and Power Generation

*Refer also to citation(s) 33618, 34432*

**33965** (ANL/CP–72862) **Materials for FBC cogeneration systems.** Natesan, K.; Podolski, W.F. Argonne National Lab., IL (United States). Mar 1991. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910909–11: 1. international conference on heat-resistant materials, Lake Geneva, WI (United States), 22-26 Sep 1991). Order Number DE91018572. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) sponsored the Atmospheric Fluidized-Bed Cogeneration Air Heater Experiment (ACAHE) to assess the performance of various heat-exchanger materials and establish confidence in the resultant designs of fluidized-bed combustion air heater systems. Westinghouse Electric Corporation, in association with Babcock and Wilcox, Foster Wheeler, and ABB/Combustion Engineering, prepared specifications and hardware for the ACAHE. Argonne National Laboratory, through a contract with the Rocketdyne Division of Rockwell International, conducted tests in the DOE 6-ft x 6-ft atmospheric fluidized-bed combustion facility in El Segundo, California. This paper presents and overview of the project, a description of the facility and test hardware, and corrosion results from several uncooled probes exposed in the facility. Alloy penetration data were determined for several of the materials as a function of specimen orientation and as a function of the exposure location in the combustor. Finally, the data are compared with previous laboratory data in support of ACAHE and an assessment is made of the long-term performance of candidate materials for air heater applications. 8 refs., 10 figs., 1 tab.

**33966** (DOE/FE–0236P) **Comprehensive report to Congress Clean Coal Technology Program: Pressurized Circulating Fluidized Bed Demonstration Project.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (United States). Office of Clean Coal Technology. Jun 1991. 26p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018504. Source: OSTI; NTIS; GPO Dep.

A project proposed by: Dairyland Power Cooperative and Iowa Power Inc.

The Pressurized Circulating Fluidized Bed (PCFB) Demonstration Project provides for repowering an existing boiler with a single PCFB combustor integrated with an oil/gas-fired topping combustor and a gas turbine module operating in a combined cycle mode. Project activities include engineering and design, permitting, procurement and fabrication, erection, start-up, pre-operation, and demonstration. The project represents the world's first commercial application of the PYROFLOW PCFB Technology. In this process coal is combusted at about 1600°F in a circulating fluidized bed contained within a pressure vessel. Limestone is used within the bed to absorb sulfur compounds. Particulates from the hot, pressurized combustion gases are removed by a ceramic filter. The clean gases are then expanded through a gas turbine. During peak load demand periods, the topping combustor will be fired with either natural gas or fuel oil to raise the inlet temperature of the gases entering the gas turbine. Higher turbine operating temperature increases the turbine efficiency and power output. Inclusion of the topping combustor will demonstrate an important step in the development of second generation pressurized fluidized-bed (PFB) combustion systems. Steam generated within the PCFB combustor and the heat recovery steam generator down-stream from the gas turbine will be used to generate power in the existing steam turbine. 6 figs., 1 tab.

33967 (DOE/METC–89/6105, pp. 351-365) **METC in-house gasification research.** Strickland, L.D. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The Gasifier Island concept is being developed as an attractive concept for coal-based electric power systems. The concept involves developing small combined-cycle gasification systems in the 100- to 250-MW range that are compatible with modular, standardized, and shop-fabricated components. METC maintains a lead position in the development of this concept through an in-house research program that focuses on hot gas cleanup issues. In situ sulfur capture coupled with hot external sulfur capture systems are key areas emphasized in the METC research. Of particular importance is the demonstration of a fully integrated gasifier/hot gas cleanup system at a reasonable process development scale. The METC program addresses the technical issues through a series of laboratory and sidestream units and is planning an integrated PDU-scale test of the most promising concepts.

33968 (DOE/PC/90098–T1) **Predictive modelling of boiler fouling: Quarterly technical progress report, January 1, 1991–March 31, 1991.** Textron, Inc., Everett, MA (United States). Textron Defense Systems. [1991]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90098. Order Number DE91018737. Source: OSTI; NTIS; GPO Dep.

The primary objective of this work is the development of a comprehensive numerical model describing the time evolution of fouling under realistic heat exchanger conditions. As fouling is a complex interaction of gas flow, mineral transport and adhesion mechanisms, understanding and subsequently improved controlling of fouling achieved via appropriate manipulation of the various coupled, nonlinear processes in a complex fluid mechanics environment will undoubtedly help reduce the substantial operating costs incurred by the utilities annually, as well as afford greater flexibility in coal selection and reduce the emission of various pollutants. In a more specialized context, the numerical model to be developed as part of this activity will be used as a tool to address the interaction of the various mechanisms controlling deposit development in specific regimes or correlative relationships. These should prove of direct use to the coal burning industry. 11 figs.

33969 (DOE/PC/90098–T2) **Predictive modelling of boiler fouling: Quarterly technical progress report, April 1, 1991–June 30, 1991.** Textron, Inc., Everett, MA (United States). Textron Defense Systems. [1991]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90098. Order Number DE91018738. Source: OSTI; NTIS; GPO Dep.

The primary objective of this work is the development of a comprehensive numerical model describing the time evolution of fouling under realistic heat exchanger conditions. As fouling is a complex interaction of gas flow, mineral transport and adhesion mechanisms, understanding and subsequently improved controlling of fouling achieved via appropriate manipulation of the various coupled, nonlinear processes in a complex fluid mechanics environment will undoubtedly help reduce the substantial operating costs incurred by the utilities annually, as well as afford greater flexibility in coal selection and reduce the emission of various pollutants. In a more specialized context, the numerical model to be developed as part of this activity will be used as a tool to address the interaction of the various mechanisms controlling deposit development in specific regimes or correlative relationships. These should prove of direct use to the coal burning industry. 11 figs.

33970 (DOE/PC/90547–T3) **Evaluation of gas-reburning and low $NO_x$ burners on a wall fired boiler: Technical progress report No. 3, April 1, 1991–June 30, 1991.** Energy and Environmental Research Corp., Irvine, CA (United States). 15 Jul 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-91PC90547. Order Number DE91018323. Source: OSTI; NTIS; GPO Dep.

The primary objective of this Clean Coal Technology (CCT) project is to evaluate the use of Gas Reburning and Low $NO_x$ Burners (GR- LNB) for $NO_x$ emission control from a wall fired boiler. With GR, about 80–85 percent of the coal fuel is fired in the main combustion zone. The balance of the fuel is added downstream as natural gas to create a slightly fuel rich environment in which $NO_x$ is converted to $N_2$. The combustion process is completed by over-fire air addition. $SO_x$ emissions are reduced to the extent that natural gas replaces sulfur-containing coal. The level of $NO_x$ reduction achievable with 15–20% natural gas is on the order of 50–60%. Technical objectives are to: demonstrate the full effectiveness of GR-LNB for $NO_x$ emission control – the performance of the separate technologies and of the integrated GR-LNB technology; demonstrate the compatibility of GR-LNB with existing wall fired boilers; demonstrate the additional reductions in $SO_2$, particulate and $CO_2$ achievable with GR-LNB; demonstrate the synergism of GR-LNB with sorbent injection for $SO_2$ control if a sorbent injection system is installed outside the scope of this project; develop a data base which can be used to establish the commercial viability of GR-LNB to meet existing and projected emission control regulations; and transfer the project results to industry to ensure that GR-LNB is a recognized cost effective competitor for utility boiler emission control.

33971 (EPRI-GS–6976 B1.1-B1.8) **Structural design of shells for EDF [Electricite de France] cooling towers.** Chauvel, D. (Electricite de France, Villeurbanne (France)); Bozetto, P. Electric Power Research Inst., Palo Alto, CA (United States). Sep 1990. (CONF-9005267–: 7. international association for hydraulic research cooling tower and spraying pond symposium, Leningrad (USSR), 29 May - 2 jun 1990). In *International cooling-tower and spray pond symposium. Proceedings.* 605p. Source: Research Reports Center, Box 50490, Palo Alto, CA 94303.

As the failure of a shell of a cooling tower would be a very serious economic problem for the owner, Electricite de France has defined specifications for the constructions of these shells: the C.S.T. This document is a collection of regulations centered on research into the durability of such structures and is based on: the geometric limitations of the shell height, bending radius of the meridian, thickness, etc...; the permissible stresses in the steel and concrete, in compression and tension under the various loadings; the determination, with the aid of a numerical calculation, of stability under extreme conditions; the arrangement of the reinforcement, the stiffeners and choice of materials; the quality of control of construction. These rules are the synthesis of the construction of twenty five large cooling towers and are based on fifteen years of research and development. The most recent structures, which are the world's highest with 172,5 m at Chooz and 178,5 m at Golfech, are supported by columns which improve the performance of the cooling tower.

33972 (IKE–2-85) **Possible contributions of violent steam explosions to the accident course in the melting furnace of the Zolling 3 IAW coal power station.** Froehlich, G.; Unger, H.;

Linca, A.; Schatz, A. Stuttgart Univ. (Germany). Inst. fuer Kernenergetik und Energiesysteme. Oct 1988. 292p. (In German). Order Number DE92714374. Source: OSTI; NTIS (US Sales Only).

The reasons for assuming a contribution of steam explosions (molten slag/water explosions) in the accident in power station unit 3 in Zolling are pointed out. The investigation of slag fragments suggests steam explosions whose scale must have been of great importance for the accident course. The occurred damage and the accident course can be explained in principle alone from the effect of steam explosions. In this case, an optimal course had to be presupposed, however, with the corresponding energy release. A combination of several different destruction factors is more probable. Chemical explosions have also participated in addition to steam explosions presumably. Steam explosions favor ignition and effectiveness of chemical explosions through fragmentation processes and fast distribution of matter into the environment. Further energy releases occur after pipe ruptures through the escaping steam/water mixture. (orig.).

**33973** (ORNL/M–1524) **Conference on fossil energy materials abstracts.** Oak Ridge National Lab., TN (United States). [1991]. 59p. Sponsored by USDOE, Washington. DC (United States). DOE Contract AC05-84OR21400. (CONF-9105184–Absts.: 5. annual conference on fossil energy advanced research and technology development (AR&TD) of materials, Oak Ridge, TN (United States), 13-16 May 1991). Order Number DE91016845. Source: OSTI; NTIS; GPO Dep.

The objective of the Fossil Energy (AR&TD) Development Materials Program is to conduct research and development on materials for fossil energy applications, focusing on the longer-term needs for materials with general applicability to the various fossil fuel technologies. Research is aimed at a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial improvement in plant operations and reliability. The scope of the AR&TD Program addresses materials requirements for all fossil energy systems, including materials for coal processing, coal liquefaction, coal gasification, heat engines and heat recovery, combustion systems, and fuel cells. Work is in progress at national and government laboratories, universities, and industrial research facilities in the following areas: ceramics; corrosion and erosion; new alloys; and, technology development and transfer.

**33974** (ORNL/Sub–88-SB775/02) **Evaluation of the fabricability of advanced austenitic tubing.** Topolski, M.J. (Babcock and Wilcox Co., Alliance, OH (United States). Research and Development Div.). Oak Ridge National Lab., TN (United States); Babcock and Wilcox Co., Alliance, OH (United States). Research and Development Div. Mar 1991. 85p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91017158. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy Advanced Research and Technology Development (AR&TD) Fossil Energy Materials Program in 1986 began a six-year activity to investigate candidate alloys fro advanced steam cycle superheaters and reheaters. The specific advanced austenitic alloys of interest were defined through a screening program which assessed strength and metallurgical stability within the temperature range of 650 to 760C. One task in the program addresses the fabrication of tubing from alloys containing controlled amounts of MC- carbide forming additions and the cladding or surface treating of tubing for optimum corrosion resistance. These alloys are members of a family of HT-UPS (high-temperature, ultrafine precipitate) austenitic alloys. Under the current research effort, a heat of 20Cr- 30Ni-Mo (m800H) was successfully melted, cast, and hot rotary forged into billet stock. Hot extrusion of wrought monolithic and alloy 690 and 671 clad m800H and LSS was demonstrated. Furthermore, cold tube- reducing of monolithic and alloy 690 clad m800H and LSS was successfully demonstrated. Alloy 671 clad composite hollows, however, could not be cold reduced because of a blocky carbide discontinuous network at the interface. Monolithic and alloy 690 clad m800H and LSS tubes were solution treated at 2175°F (1190C) and 5–10% cold worked. Weld cladding of m800H and LSS with alloy 690 or MIG72 was successfully demonstrated. LSS was also chromize surface-treated during this research effort. And, four laboratory heats of LSS and m800H were modified to yield improved heat-affected zone liquation cracking resistance. 17 refs., 21 figs., 6 tabs.

**33975** (ORNL/TM–11893) **High-temperature corrosion of Nicalon®/SiC composites.** Lowden, R.A.; James, R.D. Oak Ridge National Lab., TN (United States). Aug 1991. 29p. Sponsored by USDOE, Washington. DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000281. Source: OSTI; NTIS; GPO Dep.

The elevated-temperature stability of Nicalon® (Nippon Carbon Company, Tokyo, Japan)/SiC composites with a graphitic carbon interface layer in oxidizing and simulated fossil fuel environments was investigated. Composite specimens with and without an external SiC surface coating were oxidizing in air and exposed to a variety of combustion environments at a temperature of 1273 K. A burner rig furnace was constructed for simulating corrosive fossil fuel environments containing water vapor, sulfur, and sodium. The mechanical properties of unprotected Nicalon®/SiC specimens were degraded after short periods of exposure, due to the oxidation of the carbon interface coating. Longer exposures resulted in the oxidation of the fibers and matrix to form silica, which with time bonded the components together and produced brittle behavior. Combustion environments hastened the embrittlement of composites without an external SiC coating. Conversely, the specimens protected by a chemical vapor deposition (CVD) SiC surface coating exhibited only small decreases in strength after oxidation or corrosion in combustion environments. The SiC layer sealed off the surface of the composites, protecting the exposed fibers' ends, and thus prevented oxidation at the fiber-matrix interface. 26 refs., 11 figs., 1 tab.

## 2002 Waste Management

*Refer also to citation(s) 33966, 33970*

**33976** (CONF-9109162–1) **Permitting and solid waste management issues for the Bailly Station wet limestone Advanced Flue Gas Desulfurization (AFGD) system.** Bolinsky, F.T. (Pure Air, Allentown, PA (United States)); Ross, J.; Dennis, D.S.; Huston, J.S. Pure Air, Allentown, PA (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-90PC89660. From Industrial Gas Cleaning Institute forum '91; Washington, DC (United States); 11-13 Sep 1991. Order Number DE92000287. Source: OSTI; NTIS; GPO Dep.

Pure Air (a general partnership between Air Products and Chemicals, Inc., and Mitsubishi Heavy Industries America, Inc.). is constructing a wet limestone co-current advanced flue gas desulfurization (AFGD) system that has technological and commercial advantages over conventional FGD systems in the United States. The AFGD system is being installed at the Northern Indiana Public Service Company's Bailly Generating Station near Gary, Indiana. The AFGD system is scheduled to be operational by the Summer, 1992. The AFGD system will remove at least 90 percent of the sulfur dioxide ($SO_2$) in the flue gas from Boilers 7 and 8 at the Station while burning 3.2 percent sulfur coal. Also as part of testing the AFGD system, 95 percent removal of $SO_2$ will be demonstrated on coals containing up to 4.5 percent sulfur. At the same time that $SO_2$ is removed from the flue gas, a gypsum by-product will be produced which will be used for wallboard manufacturing. Since the AFGD system is a pollution control device, one would expect its installation to be received favorably by the public and regulatory agencies. Although the project was well received by regulatory agencies, on public group (Save the Dunes Council) was initially concerned since the project is located adjacent to the Indiana Dunes National Lakeshore. The purpose of this paper is to describe the project team's experiences in obtaining permits/approvals from regulatory agencies and in dealing with the public. 1 ref., 1 fig., 2 tabs.

**33977** (DOE/PC/79798–T12) **Environmental monitoring for the DOE coolside and LIMB demonstration extension projects: Final report, August–October 1990.** White, T.; Contos, L. Radian Corp., Research Triangle Park, NC (United States). Progress Center. May 1991. 62p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract FC22-87PC79798. Order Number DE91014762. Source: OSTI; NTIS; GPO Dep.

The objective of the Limestone Injection Multistage Burner (LIMB) program is to demonstrate the sulfur dioxide ($SO_2$) and nitrogen oxide ($NO_x$) emission reduction capabilities of the LIMB system. The LIMB system is a retrofit technology to be used for existing coal-fired boilers equipped with electrostatic precipitators (ESPs). This report is organized as follows: Section 1.0 is the introduction; Section 2.0 presents a summary of the project for the stated reporting period; Section 3.0 discusses the LIMB process and the project status; Section 4.0 presents source monitoring information; Section 5.0 presents ambient monitoring information; Section 6.0 presents the health and safety related information; Section 7.0 discusses the compliance monitoring status; Section 8.0 discusses quality assurance/quality control results; and, Section 9.0 presents monitoring problems and recommendations for change. Supporting material related to air emissions and water discharges is presented in the appendices. 5 figs., 9 tabs.

**33978** (DOE/PC/90292–T3) **Alternative formulations of regenerable flue gas cleanup catalysts: Progress report, March 1, 1991–May 31, 1991.** Mitchell, M.B.; White, M.G. Clark Atlanta Univ., GA (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90292. Order Number DE91018667. Source: OSTI; NTIS; GPO Dep.

Research on flue gas clean-up continued. We have examined the dehydration behavior of the two particular aluminas which we have chosen to use as "standard" materials, a 99.995% pure $\gamma$-alumina from Goodfellow with a surface area of 110–150 $m^2/g$ and a "commercial" alumina from Alcoa, containing significant amounts of Boehmite, with a surface area of 325 $m^2/g$. Figures 1 through 4 are the thermogravimetric analysis (TGA) results from the two different materials. Figures 1 and 2 show the present weight losses as a function of temperature for the Goodfellow and Alcoa aluminas, respectively. The Goodfellow alumina loses approximately 7% of its total weight on heating to 800°C, while the Alcoa alumina loses 18.75%. 2 refs., 6 figs.

**33979** (DOE/PC/90309–3) **Anion-exchange resin-based desulfurization process: Quarterly technical progress report, April 1, 1991–June 30, 1991.** Sheth, A.C.; Strevel, S.D. Tennessee Univ., Tullahoma, TN (United States). Space Inst. [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90309. Order Number DE92000304. Source: OSTI; NTIS; GPO Dep.

Under the current grant (FG22-90PC90309), the University of Tennessee Space Institute (UTSI) will carry out the necessary bench scale experiments to further develop it anion-exchange, resin-based desulfurization concept to desulfurize alkali metal sulfates. In particular, it is planned to screen commercially available resins and then carry out process optimization work with three selected resins. Further optimization of the resin regeneration step as well as evaluation of the effect of various performance enhancers will then be carried out with one selected resin. A process schematic, to be developed based on the bench scale results, will be used to estimate the related economics. Some limited scope testing will also be carried out using the spent-seed and sorbent materials obtained from both the coal-fired magnetohydrodynamics (MHD) and the in-duct sorbent injection pilot scale facilities. During this reporting period, 90% of the planned batch mode screening experiments for the eleven samples of candidate resins were completed. Preliminary evaluation of the resulting data is continuing in order to select a smaller number (3–4) of samples for screening in the fixed-bed setup. The installation of the semi-automated fixed-bed setup is about 70% complete and shakedown experiments will be started in 3–4 weeks. Progress made in relation to these activities is presented below. 2 figs., 3 tabs.

**33980** (DOE/PC/90361–T3) **Catalytic fabric filtration for simultaneous $NO_x$ and particulate control: Quarterly technical progress report, April 1–June 30, 1991.** Weber, G.F.; Ness, S.R. North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center. Jul 1991. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC22-90PC90361. Order Number DE91018665. Source: OSTI; NTIS; GPO Dep.

This program involves the development of a catalytic fabric filter for simultaneous $NO_x$ and particulate control. The idea of applying either permanent or throwaway catalysts to a high- temperature fabric filter for $NO_x$ control is not new. However, advances at Owens-Corning Fiberglass (OCF) have shown that a high-activity catalyst can be applied to a high-temperature woven glass cloth resulting in a fabric filter material that can operate at temperatures higher than commercially available, coated glass fabric. In bench-scale experiments, over 90% of the $NO_x$ is removed by catalytic reduction with ammonia to form nitrogen and water. The catalyst employed at this time is vanadium/titanium, but the exact catalyst composition and the unique method of applying the catalyst to high-temperature glass fabric are the property of OCF. Other catalyst options are being evaluated by OCF in order to improve catalyst performance and minimize catalyst cost. 7 refs., 8 figs., 4 tabs.

**33981** (DOE/PC/90548–T2) **LIFAC Sorbent Injection Desulfurization Demonstration Project: Quarterly report No. 2, January–March 1991.** LIFAC North America, Oakland, CA (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC22-91PC90548. Order Number DE91018335. Source: OSTI; NTIS; GPO Dep.

Progress is described on the Sorbent Injection Desulfurization Demonstration Project. The host site for this $17 million, three-phase project in Richmond Power and Light's Whitewater Valley Unit No. 2 in Richmond, Indiana. The technology uses upper-furnace limestone injection with patented humidification of the flue gas to remove 75–85% of the sulfur dioxide ($SO_2$) in the flue gas. This report describes activities associated with management, equipment design, and environmental monitoring.

## 2005 Environmental Aspects

*Refer also to citation(s) 33966, 33976*

**33982** (ENEA-RTI-DCS–90-03) **Environmental impact assessment in energy project investment.** Tordi, G. ENEA, Rome (Italy). Direzione Centrale Studi Unita Valutazioni Ambientali e Socioeconomiche. 1990. 199p. (In Italian). (RTI-DCS–90-03). Order Number DE92705887. Source: OSTI; NTIS (US Sales Only).

These instructional notes on environmental impacts assessment methods first examine cost benefit analysis fundamentals, including such aspects as time dependence, analysis limits, and energy project investment analysis. The section on impacts assessment includes such topics as non-economic resource evaluation; the function of economic indicators; physical values homogenization and aggregation; weight of compromised resources; and technical evaluation techniques. Risk assessment and, in particular, public perception of risk are then discussed. The dynamics of Italy's energy policy, concerning priorities in meeting the future electric power demand, are then related to the environmental assessment methodology. Finally, comparisons are made with the assessment methods adopted by the European Communities and the provisions contained in Italian laws on environmental protection.

## 2006 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 33982*

**33983** (CRIE-Y–90013) **Ramsey pricing in Electric power industry.: Empirical analysis of optimal pricing with intermodal competition.** Matsukawa, I. (Center Research Inst. of Electric Power Industry, Tokyo (Japan)); Madono, S.; Nakashima, T. Central Research Inst. of Electric Power Industry, Tokyo (Japan). Apr 1991. 44p. (In Japanese). Order Number DE92709574. Source: OSTI; NTIS (US Sales Only).

The rapid increase in self-generation and cogeneration includes the danger to result in the reduction of the utilization factor of the existing power system and the increase of fixed cost burden. If the fixed cost burden is shared by customers, a vicious cycle of tariff rise, demand decrease and tariff rise may occur. On the other hand, when the system power is affected, the management base may deteriorate. As an approach to avoid social inefficient outcomes, Ramsey pricing system which provides lower rates for

price-elastic customers. was reviewed. This study empirically examines Ramsey pricing for Japanese electricity utilities. estimating marginal cost and price elasticities of electricity for residential and industrial customers. The estimation results indicate that own-price elasticity of electricity for the industrial customers is −0.63 and that for the residential customers is −0.37. The marginal cost of electricity supply for the residential customers is greatly higher than that of the industrial customers. The separation does no exist between the Ramsey pricing and the present pricing based on the assignment of individual cost. It was found that the industrial customers could have lower rates than the current rates except the case where the residential customers would have remarkably higher rates than the current rates. 53 refs., 11 figs., 7 tabs.

### 2007 Legislation and Regulations

*Refer also to citation(s) 33976*

## 21 NUCLEAR POWER PLANTS

**33984** (ORNL/NSP–91/1) **Status of conversion of NE standards to national consensus standards.** Jennings, S.D. Oak Ridge National Lab., TN (United States). Jul 1991. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91018523. Source: OSTI; NTIS; INIS; GPO Dep.

One major goal of the Nuclear Standards Program is to convert existing Nuclear Energy (NE) standards into national consensus standards (where possible). This means that an NE standard may form the basis for a standards-writing committee to produce a standard in the same subject area using the national consensus process. This report is a summary of the activities that have evolved to effect conversion of NE standards to national consensus standards, and the status of current conversion activities. In some cases, all requirements in an NE standard will not be incorporated into the published national consensus standard because these requirements may be considered too restrictive or too specific for broader applications by the nuclear industry. If these requirements are considered necessary for nuclear reactor program applications, the program standard will be revised and issued as a supplement to the national consensus standard. The supplement program standard will contain only those necessary requirements not reflected by the national consensus standard. Therefore, while complete conversion of program standards may not always be realized, the standards policy has been fully supported in attempting to make maximum use of the national consensus standard. 1 tab.

**33985** (UCRL-JC–107642) **On reactor type comparisons for the next generation of reactors.** Alesso, H.P.; Majumdar, K.C. Lawrence Livermore National Lab., CA (United States). 22 Aug 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911107–31: Winter meeting of the American Nuclear Society (ANS), San Francisco, CA (United States), 10-15 Nov 1991). Order Number DE91019013. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper, we present a broad comparison of studies for a selected set of parameters for different nuclear reactor types including the next generation. This serves as an overview of key parameters which provide a semi-quantitative decision basis for selecting nuclear strategies. Out of a number of advanced reactor designs of the LWR type, gas cooled type, and FBR type, currently on the drawing board, the Advanced Light Water Reactors (ALWR) seem to have some edge over other types of the next generation of reactors for the near-term application. This is based on a number of attributes related to the benefit of the vast operating experience with LWRs coupled with an estimated low risk profile, economics of scale, degree of utilization of passive systems, simplification in the plant design and layout, modular fabrication and manufacturing. 32 refs., 1 fig., 3 tabs.

### 2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

*Refer also to citation(s) 34033, 34034, 34054, 34116, 34124, 34128, 34132, 34183, 34202, 34203, 34204, 34205, 34781, 35033, 35034, 35035, 35038, 35039, 35046, 35048*

**33986** (CIEMAT–668) **BWR stability using a reduced dynamical model.** Ballestrin, J.M.; Blazquez, J.B. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1990. 33p. (In Spanish). Order Number DE92700008. Source: OSTI; NTIS (US Sales Only).

BWR stability can be treated with reduced order dynamical models. When the parameters of the model came from experimental data, the predictions are accurate. In this work an alternative derivation for the void fraction equation is made, but remarking the physical structure of the parameters. As the poles of power/reactivity transfer function are related with the parameters, the measurement of the poles by other techniques such as noise analysis will lead to the parameters, but the system of equations is nonlinear. Simple parametric calculation of decay ratio is performed, showing why BWRs become unstable when they are operated at low flow and high power. (Author)

**33987** (EGG-M–91047) **Three technical issues in fatigue damage assessment of nuclear power plant components.** Ware, A.G.; Shah, V.N. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1991]. 10p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-910831–8: 15. biennial conference on reactor operating experience: international conference on nuclear power plant operations, Bellevue, WA (United States), 11-14 Aug 1991). Order Number DE91018696. Source: OSTI; NTIS; INIS; GPO Dep.

This paper addresses three technical issues that affect the fatigue damage assessment of nuclear power plant components: the effect of the environment on the fatigue life, the importance of the loading sequence in calculating the fatigue crack-initiation damage, and the adequacy of current inservice inspection requirements and methods to characterize fatigue cracks. The environmental parameters that affect the fatigue life of carbon and low alloy steel components are the sulphur content in the steel, the temperature, the amount of dissolved oxygen in the coolant, and the presence of oxidizing agents such as copper oxide. The occurrence of large-amplitude stress cycles early in a component's life followed by low-amplitude stress cycles may cause crack initiation at a cumulative usage factor less than 1.0. The current inservice inspection requirements include volumetric inspections of welds but not of some susceptible sites in the base metal. In addition, the conventional ultrasonic testing techniques need to be improved for reliable detection and accurate sizing of fatigue cracks. 28 refs., 4 figs., 1 tab.

**33988** (IWGATWR–5, pp. 71-75) **Cost reduction in the ABB Atom BWR 90 project.** Loennerberg, B. (ABB Atom AB, Vaesteraas (Sweden). Reactor Div.). International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May 1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990*. 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

BWR 90 is a development of the ABB Atom design BWR 75. The latter was realized in two plants in Sweden, Forsmark 1 and 2, and two Finnish plants, TVO I and II, and was further brought to maturity in Forsmark 3 and Oskarshamn 3, in operation since 1985/1986. The present paper reviews one of the main goals of the project BWR 90 which consists in the ways how to reduce costs and facilitate a short construction time schedule. (author). 10 figs.

**33989** (IWGATWR–5, pp. 55-61) **Refuelling outage optimization.** Mokka, R. (Teollisuuden Voima Oy (Finland)). International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May

1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990.* 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

The Teollisuuden Voima Oy (TVO) operates two 710 MW nuclear power plant units in Olkiluoto on the west coast of Finland. TVO I was connected to the national grid in 1978 and TVO II in 1980. The price of the produced electricity is depending on the capacity factor of the plant. In order to avoid unplanned shutdowns and to operate at a high efficiency a good condition monitoring and an effective maintenance are needed. In this paper the development of the main maintenance period of the plant and the refuelling outage are described. (author). 11 figs.

**33990** (NUREG/CR–5696) **Irradiation effects on Charpy impact and tensile properties of low upper-shelf welds, HSSI series 2 and 3.** Nanstad, R.K. (Oak Ridge National Lab., TN (United States)); Berggren. R.G. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Aug 1991. 228p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–11804). Source: OSTI; NTIS; INIS; GPO.

When reactor pressure vessel steels exhibit Charpy V-notch impact upper-shelf energy levels of less than 68 J (50 ft-lb), the requirements of Title 10, Code of Federal Regulations, Part 50, Appendix G, are not met. The regulations require, as an option, that a fracture mechanics analysis be performed that conservatively demonstrates adequate safety margins for continued operation. Under conditions where large prefracture crack-tip plastic zones are present, linear-elastic fracture mechanics concepts are not applicable, and the use of elastic-plastic fracture mechanics concepts has been recommended by the US Nuclear Regulatory Commission. A number of Babcock and Wilcox Company-fabricated reactor vessels in commercial pressurized water reactor plants include welds with both relatively low initial Charpy upper-shelf energies and high copper concentrations, which make them highly sensitive to neutron irradiation. As a result, the Charpy upper-shelf energies of many welds are expected to fall below 68 J (50 ft-lb) prior to reaching design life. The Heavy-Section Steel Irradiation Program conducted the Second and Third Irradiation Series to investigate the effects of irradiation on the ductile fracture toughness of seven commercially fabricated, low upper-shelf welds. This report represents analyses of the Charpy impact and tensile test data, including adjustments for irradiation temperature and fluence normalization, which make possible comparison of the irradiation sensitivity the different welds.

## 2102 Power Reactors, Nonbreeding, Light-Water Moderated, Nonboiling Water Cooled

*Refer also to citation(s) 33987, 33990, 34028, 34033, 34034, 34050, 34054, 34059, 34116, 34183, 34200, 34201, 34202, 34203, 34204, 34205, 34206, 34210, 34595, 34781, 35004, 35040, 35043, 35045, 35047, 35049, 35050*

**33991** (IAEA-TECDOC–572, pp. 9-24) **Experimental and theoretical investigations for WWER pressure vessel neutron exposure evaluation in Czechoslovakia.** Osmera, B. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)). International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

A sixty degree symmetry sector of WWER-440 and WWER-1000 mock-ups in radial direction was realized in the LR-0 experimental reactor at the NRI Rez. Suitable geometrical conditions and technical arrangements of the LR-0 enable us to construct full-scale physical models of the WWER type reactors in radial direction from the core to the biological shielding of the reactor. These mock-ups represent the core periphery and radial shielding heterogeneities of the WWER-type reactors. The neutron spectrum was measured by proton recoil methods at the edge of the core, surveillance capsule position, on pressure vessel inner and outer walls. Neutron spectra calculations were performed by means of one- and two-dimensional transport codes ANISN and DOT-3.5 using data cross section libraries EURLIB-4, VITAMIN-C and CASK. The intercomparison of measured and computed data was done for differential spectra and integral quantities. The precise physical model makes it possible to obtain direct experimental estimation of some quantities for the power reactors such as fast neutron spectra at "crucial points" (surveillance specimen position, inner and outer PV wall) and some space-energy indexes for radiation damage monitoring. (author). 23 refs, 6 figs, 4 tabs.

**33992** (IWGATWR–5, pp. 17-23) **Reduction of construction periods of PWRs by optimization of detailed sequence planning.** Stocker, W. (Siemens AG Unternehmensbereich KWU, Erlangen (Germany, F.R.)); Leverenz, R. International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May 1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990.* 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

The construction of PWR's is an enterprise with high investment costs, in total up to three billion US$ and with long construction periods of five years and more. Besides the results reached by the intensive standardization, a further reduction of the construction period is possible by optimization of detailed sequence planning and interfaces of work units. During the execution of the three German Convoy plants ISAR 2, EMSLAND and NECKARWESTHEIM 2, the contractual construction periods were shortened between 4 and 8 months. These reductions were reached after individual investigations by measures like advanced finishing work activities; erection of an increased amount of prefabricated pipings; rearrangement of erection sequences; overlapping of piping erection and electrical installation; reduction of plant commissioning period. All these measures support directly the reduction of the total investment cost of a plant, as already demonstrated by the Convoy plants. (author). 8 figs.

**33993** (IWGATWR–5, pp. 23-32) **Reducing costs by reducing size.** Hayns, M.R. (AEA Technology, Harwell Lab., Harwell (UK). Thermal Reactor Services); Shepherd, J. International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May 1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990.* 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

The present paper discusses briefly the many factors, including capital cost, which have to be taken into account in determining whether a series of power stations based on a small nuclear plant can be competitive with a series based on traditional large unit sizes giving the guaranteed level of supply. The 320 MWe UK/US Safe Integral Reactor is described as a good example of how the factors discussed can be beneficially incorporated into a design using proven technology. Finally it goes on to illustrate how the overall costs of a generating system can indeed by reduced by use of the 320 MWe Safe Integral Reactor rather than conventional units of around 1200 MWe. (author). 9 figs.

**33994** (IWGATWR–5, pp. 33-37) **Cost reduction of LWRs - The main features.** Board, J.A. (Nuclear Electric plc, Knutsford (UK)); Norman, D. International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May 1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the

design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990.* 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

For effective generation cost reductions to be achieved while maintaining safety levels, the impact of each of the above element and their interactions must be fully assessed, together with the effects of uncertainty on commercial risk. the amount of interest during construction which must be paid can be minimised by adopting designs, output ratings (unit size), and construction methods which minimise construction time. However this must be done without unduly increasing specific capital cost. Total capital costs can be reduced by sharing design and project launching costs and front-end design and licensing costs, across a series of identical plants. The paper is reviewing costs and performance factors such as those above with the aim of identifying the strategies which might be necessary within and between countries in order to create an environment which would enable cost reductions on LWRs to be made. (author).

**33995** (IWGATWR–5, pp. 37-44) **Standardization of PWR power plants: Impact of capital investment cost.** Vincent, C. (Electricite de France (EDF), 75 - Paris (France). Direction de l'Equipement). International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May 1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990.* 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

The French program is certainly specific to the French context but it is a large and a real experiment of standardized series of units from which we can abstract the main ideas and ranges available in different contexts. It was estimated that the standardized part could reach more than 60% of the capital cost and this percentage does not take into account a regionalized part which also could have been standardized. The main condition is a large program which could be issued from a country or a partnership between different countries. That means, common terms of reference, lists of standardized equipment, same design documents. With a levelized rhythm of erection, beneficial effects of the series could be expected. The scale effect is fairly well known, also we can wonder for instance about the choice between five units of 600 MW and three units of 1000 MW. The answer is depending on the number of units and on the discount rate. (author).

**33996** (IWGATWR–5, pp. 45-48) **Examples for cost reduction in the design of a WWER-1000 nuclear power plant.** Kukkola, T. (Imatran Voima Oy (IVO), Helsinki (Finland)). International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May 1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990.* 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

In a design project during recent years, a version for Finnish conditions has been and is being developed based on the Soviet WWER-1000 PWR plant with four horizontal steam generators. The plant will have a double containment. The inner containment will be a dry full pressure prestressed concrete containment with liner and the secondary containment will be made of ordinary concrete. Four train safety approach is adopted. It is supposed that the plant is to be designed according to the present Finnish safety requirements, e.g. severe reactor accidents are considered. When striving at an economic plant no compromises are made as far as safety is concerned. This paper describes possible cost reduction by redesigning the main technical equipment. (author). 1 ref.

**33997** (IWGATWR–5, pp. 51-55) **Possible fuel cycle cost reduction for WWERs.** Pazdera, F. (Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia)); Kujal, J. International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May 1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990.* 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper possible ways for fuel cycle cost reduction in WWER reactors are discussed. One of the most promising items is the burnup extension. The fuel cycle cost reduction was evaluated for both WWER 440 and WWER 1000 reactors. As a part the CSFR/USSR results obtained in the frame of the IAEA WREBUS study are presented. The main conclusions of this evaluation are: optimum batch average burnup is above 60 MWd/kgU; increasing back end cost strongly increases incentives for burnup extension; large political differences in price calculation for the operation in the fuel cycle back end could in some cases support unoptimal decision, to clarify this is very important. The technical and economical aspects of the last item are discussed. (author). 5 refs, 4 figs, 1 tab.

**33998** (IWGATWR–5, pp. 61-64) **Dynamic simulation in nuclear power plant design.** Laukia, A. (Imatran Voima Oy (IVO), Helsinki (Finland)); Komsi, M.; Lilja, M. International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May 1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990.* 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

Complicated process and control systems with a lot of interconnections are typical for all big process plants. The especially high standard of safety in nuclear power plants makes it very important that the safety impacts of all subsystems are studied carefully. This paper describes a new dynamic simulation system, APROS which is developed for the design of complicated process systems. The plans how the APROS system would be used in the potential new nuclear power plant project in Finland are discussed. Some experiences from the use of the system in the design of changes at the existing plants are also reported. The paper describes also a user-friendly modular plant analyser, MPA which is being developed on the basis of APROS. The aim is that MPA will be validated to be used for licencing analyses, replacing more clumsy codes. (author). 2 figs.

**33999** (IWGFPT–37, pp. 50-55) **Post-irradiation examination and evaluation of PWR 14 x 14 fuel assemblies.** Ro, Seung Gy (Korea Atomic Energy Research Inst., Daeduk (Republic of Korea)); Kim, Eun Ka; Lee, Key Soon; Min, Duck Kee. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

Post irradiation examination and evaluation for Kori-1 NPP fuel assemblies has been conducted at the post irradiation examination facility of Korea Atomic Energy Research Institute (KAERI). The three fuel assemblies under consideration had the average burnup of about 17(1-cycle burnup), 25(2-cycle burnup), 32(3-cycle burnup) GWD/MTU. Nondestructive examination and dismantling of the fuel assemblies have been performed in the pool of the PIE facility while nondestructive and destructive examinations of fuel rods have been done in the hot cell. On the bases of PIE data and the nominal design values, fuel burnup behaviours have been evaluated. It is revealed that no noticeable abnormality is found in the

fuel integrity in general. However, an apparent axial growth of peripheral fuel rods in the assembly with 2-cycle burnup seems to be high compared to that of 3-cycle burnup as an exceptional case. (author). 3 refs. 6 figs, 3 tabs.

**34000** (IWGFPT–37, pp. 55-62) **Eddy current testing system for measuring oxide layer thickness of fuel rods.** Yamaguchi, Y. (Nuclear Development Corp., Tokai (Japan)); Ando, T.; Kamimura, T.; Abeta, S.; Oishi, M.; Yamauchi, S.; Inoue. S. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

As water side corrosion of fuel rods accompanies loss of metallic wall thickness and pickup and hydrogen, it is generally considered as one of the important factors that limit the operating life of fuel rods. Therefore, it is important to estimate properly the waterside corrosion layer thickness; and an adequate method of the thickness measurement has been looked for instead of the ordinary metallographic examination method which needs both time and cost. Then, the eddy current testing system has been developed to measure the layer thickness more easily and accurately. This system measures the oxide layer thickness by scanning the fuel rod in direction to the axis of fuel rod at the speed of 20 mm/s keeping the probe pushed down on the surface of a fuel rod. As the distance between the tip of probe and the surface of fuel rod significantly affects the read our of the thickness, the measuring unit inside the probe holder case (110x60x80 mm) was so designed as the probe always to contact with the surface of rod with a constant pressure. The data processing equipment records the testing conditions, the eddy current signals (voltage), the measured positions etc; thereby the signals are converted into oxide layer thickness. The output of thickness can be printed out as digital values or plotted in several kinds of graphic representation such as axial or circumferential distributions. The mock-up test of this system was carried out by measuring an irradiated fuel rod from a commercial reactor as well as the standard calibration rods which had several different thickness on them (by autoclave treatment, plastic films, etc.). The results were compared with those from other methods (mostly by metallographic examination), and it was found that both results well agreed within the error of +-5$\mu$ m, which demonstrated that the proposed system is practical enough for the oxide layer measurement. (author). 3 refs, 12 figs, 2 tabs.

**34001** (IWGFPT–37, pp. 63-69) **Application of PIE techniques to the study of corrosion of spent oxide fuel in deep-rock groundwaters.** Forsyth, R.S. (Studsvik AB, Nykoeping (Sweden)). International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

The direct disposal of spent fuel is an increasingly favoured alternative to fuel reprocessing and subsequent vitrification of the highly active waste solutions for the closure of the nuclear fuel cycle. The direct disposal route is based on a multi-barrier concept, one barrier being the corrosion resistance of the fuel itself. Corrosion of spent fuel in groundwaters is being studied in several countries, and the results currently available suggest three, partly overlapping, processes, of which two in particular are dependent on structural changes and migration effects produced in the fuel during reactor irradiation. Thus, in order to be able to define and quantify these processes for the purpose of safety analysis, it is necessary that, in addition to extensive leachant analysis after corrosion tests, PIE techniques are applied to the detailed study of spent fuel both before and after water contact. This paper presents results and observations from the Swedish programme which illustrate the problems involved. (author). 10 refs, 11 figs, 1 tab.

**34002** (IWGFPT–37, pp. 77-82) **Link between in pile instrumentation and hot cell measurements for fuel behaviour analysis.** Porrot, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)); Eminet, G.; Baudusseau, C.; Lemaignan, C. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

For a better understanding of fuel behaviour, various types of information are to be obtained. In the current field of PWR fuel research, the main interests concern pellet cladding interaction during power transients, fission gas release during steady state operation at high burn-up or during transients and cladding oxidation kinetics. For PCI behaviour, one has to determine the strain of the cladding induced by fuel expansion during a transient. This is obtained with a good accuracy using on line measurements like strain gages welded on the cladding or diameter measurement devices during irradiation, leading to a good information of the kinetics of deformation, in connection with fine PIE rod profilometry for absolute references. Fission gas release are obtained by on line sweeping during irradiation giving information on the instantaneous release, and rod puncturing in hot cells. If the first technique gives details on the mechanisms by an analysis of the release ratios of the various isotopes, global behaviour is reached by the second one. Understanding of the mechanisms of FGR requires additional experimental facilities in order to be able to analyze the local FGR rate during thermal transient: Micro-drilling of fuel sections, gas collection during heat treatment of those samples, SEM examination of the microstructure afterwards. The paper describes those techniques used in the pile and hot cells at CEN-Grenoble for improvement of the fuel behaviour understanding or testing of advanced fuel design. It focuses also on the necessary conjunction of In-pile and Post-Irradiation Examination for analytical measurements. (author). 4 refs, 5 figs.

**34003** (IWGFPT–37, pp. 95-103) **Measurement methods of geometry dimensions and shape of irradiated fuel assembly for power reactors.** Dvoretskij, V.G. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)); Ivanov, V.B.; Glushak, N.S.; Glushak, S.M.; Karaulov, E.D.; Smirnov, V.P. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

This report contains technical and methodical aspects of remote measurements of shape changes of irradiated hexagonal fuel assembly wrappers. The main terms are defined for the following parameter calculation methods: dimension over sides, convexity, fuel assembly axis deflection (bowing), helicity (twisting). The possibilities of the hot material science laboratory (RIAR) are illustrated on the example of shape change measurements for spent standard fuel assembly of the BOR-60 reactor. (author). 4 refs, 10 figs.

**34004** (IWGFPT–37, pp. 135-140) **Use of local X-ray microanalysis methods in studies of WWER fuel elements.** Dubrovin, K.P. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Novikov, A.V.; Shtrombakh, Ja.I. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel:*

*Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

The paper reviews experience in setting up an X-ray microanalysis facility in the technological line of hot cells at the I.V. Kurchatov Institute of Atomic Energy. Placing an X-ray microanalysis instrument in a standard hot cell greatly simplified operations with high-activity fuel element specimens, it also provided for increased productivity and safety of research. As an example the method of investigations and the results of the X-ray microanalysis performed on the specimens from a Rovno NPP fuel element operated at an elevated heat rating are given. (author). 1 ref., 9 figs.

**34005** (IWGFPT–37, pp. 148-150) **On-site examination of individual fuel rods.** Beuneche, D. (Fragema, 69 - Lyon (France)). International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

In order to evaluate the behaviour of its new products under irradiation, and to determine the causes of failures of fuel rods, FRAGEMA has developed a complete set of equipment to examine individual irradiated fuel rods on reactor sites. This set includes: tools to withdraw rods from irradiated fuel assemblies (of the repairable type such as the AFA fuel as well as of the standard fuel not repairable by construction); equipment for visual examination, cladding integrity evaluation, dimensional measurements and oxide thickness determination. This equipment is used during fuel assembly repair (to characterize precisely the condition of the leaking or damaged fuel rods extracted from the assemblies, and provide information to determine the causes of failure), or during fuel surveillance campaigns (for assemblies to be reirradiated, or before the shipment of irradiated fuel to hot cells for destructive examination, in order to evaluate rapidly some key characteristics). (author). 4 figs.

**34006** (IWGFPT–37, pp. 151-157) **A new computed tomography system in the ECN Hot Cell Laboratory, Netherlands.** Dassel, G. (Netherlands Energy Research Foundation, Petten (Netherlands)); Leendertse, G.P.; Wijk, J.J. van. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

The geometrical distribution of a radio-nuclide in some cross-section of a fuel rod can be determined by measuring its gamma-intensity coming from those strips of the cross-section which are visible to a collimator detector system. Moving the rod along the measurement equipment (so as to obtain the intensity of many strips) and repeating this procedure for different rotation angles, provides the necessary information to allow for the computation of the distribution. Reconstructing this image on the basis of measured projections with the aid of a computer algorithm is the objective of what is called Computed Tomography (CT). The form in which it appears at ECN/HCL is referred to as Emission CT (ECT). The adopted approach is to regard it as a least squares problem where the "theroetical" projections (arising from a "hypothetical" distribution) should fit to the measured projections as closely as possible. A hypothetical distribution follows after some appropriate discretization of the problem. The least squares problem is then solved through an iterative technique. A such a variant of the Pre-conditioned Conjugate Gradients method is applied. The CT-software provides for graphical output (surface views, contours) of the resulting - optionally smoothed - distribution. Usage is interactive, command-driven. (author). 3 refs, 6 figs.

**34007** (IWGFPT–37, pp. 158-162) **Permanent measurement of the primary coolant activity with the PIGAL experimental facility.** Parrat, D. (CEA Centre d'Etudes Nucleaires de Grenoble, Grenoble (France). Dept. de Thermohydraulique et de Physique); Warlop, R.; Montagnon, F. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

The appearance of failures on fuel rod clads in a PWR is monitored through sampling and analysis of the radioactive fission products carried by the primary system. In France, the periodicity of such measurements can be high, especially when an expected operating transient occurs: one spectrometry measurement every two hours approximately, for several days. These analyses require several manual handlings (sampling, transfer, counting), and involve working load, dose rates and sample accumulation problems. With the aim of solving these difficulties, CEA/Direction des Reacteurs Nucleaires and EDF/Service Etudes et Projets Thermiques et Nucleaires have jointly developed an entirely automatic system: the PIGAL (Industrial Prototype of on-Line GAmma spectrometry) experimental facility. This device allows the permanent measurement of the primary coolant activity of two coupled units, without any human action nor handling of active samples. In the absence of specific instructions from an operator, the facility is designed to provide automatically 2, 6 or 12 measurements per day, as well as a delayed analysis (detection of long-life isotopes). A systematic edition summarizes all measurements performed every day. A periodically rinsing avoids the deposits of radioactive products on the walls of the measurement capacity. In addition, an operator's action from a monitor-keyboard allows: counting at higher frequency, checking of the detector efficiency, rinsing of system and measurement of background, display of spectra and edition of intermediate results: detected peaks, identified isotopes, unidentified peaks... At present, the PIGAL experimental facility is used at units 2 and 3 of the BUGEY Nuclear Power Station since 1987. The operation of this device is quite satisfactory: long half-life (Iodine 131) and very short half-life (Krypton 89) isotopes are detected, and the background activity level of the deposits is always negligible. (author). 5 figs.

**34008** (KFK–4884) **Experimental investigation of the critical heat flux in 8 mm circular tubes and in 7-rod bundles.** Cheng, X. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Reaktorbauelemente; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung; Technische Univ. Braunschweig (Germany). Jul 1991. 187p. (In German). Order Number DE92714471. Source: OSTI; NTIS (US Sales Only); INIS.

In a broad framed research program to develop a high conversion pressurized water reactor (HCPWR), experiments of critical heat flux (CHF) in 8 mm circular tubes and in closely spaced 7-rod bundles are performed. Freon 12 is used as working fluid. The influence of different parameters on CHF, e.g. pressure, mass flux, steam quality, tube diameter, spacers and power distributions is investigated. CHF fluid-to-fluid modelling is used to transfer the test results to water conditions. The CHF experiments with 8 mm tubes yield an increase of critical heat flux with increasing mass flux under HCPWR conditions. A HCPWR therefore shows an attractive CHF-behaviour due to its high mass fluxes compared to a conventional PWR. The test results in 8 mm tubes, combined with the test results of other authors, underline that correlations in the literature can not reproduce the diameter influence on CHF with sufficient accuracy. The experiments with 7-rod bundles show on the basis of the same hydraulic diameters much lower CHF values compared to the tube experiments. The influence of spacers (grid spacer and wire wrap) on CHF is found to be substantially governed by the local steam quality. For low steam quality wire wraps lead to higher CHF. An opposite influence of spacers on CHF is found for high steam quality. CHF increases during the transition from uniform to

non-uniform power distributions. The test results with different radial power distributions can qualitatively be explained by using a subchannel analysis. These experiments deliver a data base for the verification of subchannel analysis codes. (orig./GL).

**34009** (Risley-Trans–6062) **Investigation after one cycle on DOEL 3 tubes sleeved by Westinghouse.** Laire, Ch. (Laboratoire Belge de l'Industrie Electrique (LABORELEC), Linkebeek (Belgium)); Stubbe, J. AEA Technology, Risley (United Kingdom). 3 Jun 1991. 12p. Translated from Belgian. Order Number DE92601464. Source: OSTI; NTIS (US Sales Only); INIS.

Translated from Belgian.

At DOEL 3, 55 steam generator tubes cracked at the roll transition were repaired by Westinghouse in 1988 by $CO_2$ laser welded sleeving, with post weld stress relieving. After one cycle, two sleeved tubes were pulled out for examination. The main purpose of this examination was the correlation with the on-site ultrasonic inspection performed after sleeving, because surface irregularities of the weld had interfered with the determination of weld penetration in the case of several sleeves. Good correlation between the ultrasonic results and the direct examination was found for the two tubes, which are both affected by surface irregularities on the majority of the circumference. Another important goal of the examination is the verification of the resistance to primary water stress corrosion cracking of the upper joint of the sleeve. After one year's service, no degradation was observed so that it was decided to keep all the other sleeves in service. This examination also shows the differences between the pulled-out tubes and the laboratory models examined beforehand, which highlights the problem of the reproducibility of such a process. (author).

**34010** (Risley-Trans–6064) **Chemical cleaning of steam generators: application to Nogent 1.** Fiquet, J.M. (Electricite de France (France)); Veysset, J.P.; Esteban, L.; Saurin, P. AEA Technology, Risley (United Kingdom). 3 Jun 1991. 13p. Translated from French. Order Number DE92601465. Source: OSTI; NTIS (US Sales Only); INIS.

Translated from French.

EDF has patented a chemical cleaning process for PWR steam generators, based on the use of a mixture or organic acids in order to dissolve iron oxides and copper with a single solution and clean dented crevices. Qualification tests have permitted to demonstrate effectiveness of the solution and its innocuousness related to steam generator materials. The process, the licence of which belongs to SOMAFER RA and Framatome has been implemented in France at Nogent. The goal was to dissolve iron oxides allowing metallic particles, aggregated on the tubesheet, to be released and mechanically removed. The effectiveness was satisfactory and this treatment is to be extended to other units. (author).

## 2103 Power Reactors, Nonbreeding, Graphite Moderated

*Refer also to citation(s) 34051, 34052*

**34011** (CONF-9109266–1) **The effects of specimen geometry and size on the fracture toughness of nuclear graphites.** Romanoski, G.R.; Burchell, T.D. Oak Ridge National Lab., TN (United States). [1991]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors; Tokai (Japan); 9-12 Sep 1991. Order Number DE92000056. Source: OSTI; NTIS; INIS; GPO Dep.

In a joint Oak Ridge National Laboratory (ORNL)/Japan Atomic Energy Research Institute (JAERI) study, various fracture toughness techniques were applied to Toyo Tanso grade IG-110 graphite to establish if specimen geometry influences on fracture toughness. The test geometries investigated were: compact tension (CT), disc compact tension (DCT), short rod (SR), chevron-notched short-red (CNSR), cylindrical bend specimen (BS), and centrally slotted disc (CSD). Specimen geometries which allow slow crack propagation, such as the CNSR and CT, yielded higher fracture toughness values than those where fracture is very rapid, e.g., the CSD. In a further ORNL study, the CNSR specimen geometry was selected to investigate the effect of specimen size on fracture toughness. Three specimen sizes and three grades of graphite were examined: Great Lakes Carbon grade H-451, Stackpole grade 2020, and Toyo Tanso grade IG-110. Grade H-451 was the toughest graphite, while Stackpole 2020 was the least tough. Fracture toughness increased with increasing specimen size for all graphites tested. This result was attributed to rising R-curve behavior. 13 refs., 8 figs., 3 tabs.

**34012** (CONF-9109266–2) **Spatial variability in the tensile strength of an extruded nuclear-grade graphite.** Strizak, J.P. Oak Ridge National Lab., TN (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors; Tokai (Japan); 9-12 Sep 1991. Order Number DE91018868. Source: OSTI; NTIS; GPO Dep.

This report will present the results of a study on spatial variations in the strength of nuclear-grade H-451 graphite. The tensile properties of H-451 were examined extensively in the past in order to characterize the variability of strength within billets, between billets, and between lots. But the variability within a billet was, for the most part, studied only casually. The problem appeared to be strong influence of a limited sampling plan in describing the mean strength and the viability. Therefore, an extensive, statistically sound sampling plan has been devised to fully characterize the spatial variability within a single billet. A new fracture model developed by Burchell was applied to the data with encouraging results. This probabilistic failure criteria combines a microstructural basis with a fracture-mechanics approach to failure.

**34013** (IWGFPT–37, pp. 82-87) **Post-irradiation non-destructive testing of leaky fuel pin clad in Zr-1% Nb.** Novikov, V.V. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)); Bibilashvilli, Yu.K.; Golovnin, I.S.; Demin, A.V.; Golovachev, M.G.; Timokhin, A.N.; Shcherbakov, E.N. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

The paper summarizes the results of post-irradiation examinations of RBMK fuels discharged from the second unit of the Leningrad NPP on account of the indications of the leak-tightness control system. Post-irradiation non-destructive examination of FAs irradiated to a burn-up of 13500 MW day/t U comprised a pick-up of a leaky fuel and evaluation of irradiated fuel condition. In addition to a visual examination the use was also made of an eddy current flaw detection and measurements of the electrical resistance of a cladding. Among the destructive methods are metallographic investigations of fuel and cladding, investigation of mechanical properties, determination of hydrogen content of cladding, x-ray studies. Defects were revealed in the form of intercrystalline penetrating cracks having a low critical crack opening displacement. It is assumed that cracking is due to PCI. (author). 7 figs.

**34014** (NUKEM-FuE–90013) **Improved manufacturing process for HTR fuel elements. Final report.** Pfahls, O. Nuklear-Chemie und -Metallurgie GmbH (NUKEM), Hanau (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jan 1991. 43p. (In German). Contract BMFT 03H0B111. Order Number DE92714355. Source: OSTI; NTIS (US Sales Only); INIS.

Pending items related to a state-of-the-art production line, operating continuously most of the time, to manufacture LEU fuel elements were dealt with. Both process technology matters and matters directly concerning the manufacturing plant were the subject of development work: cores, coating, fuel elements, quality control (X-ray screening). (orig./HP).

## 2104 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated

**34015** (IWGATWR–5, pp. 64-71) **CANDU 3 - Modularization.** McAskie, M.J. (Atomic Energy of Canada Ltd, Mississauga, ON (Canada). CANDU Operations). International Atomic Energy Agency, Vienna (Austria). International Working Group on Advanced Technologies for Water Cooled Reactors. May 1991. (CONF-9009419–: Specialists meeting on methods and technologies for cost reduction in the design of water cooled reactor power plants, Helsinki (Finland), 3-6 Sep 1990). In *Methods and technologies for cost reduction in the design of water cooled reactor power plants: Proceedings of a specialists meeting held in Helsinki, 3-6 September 1990.* 76p. Order Number DE92601438. Source: OSTI; NTIS (US Sales Only); INIS.

The CANDU 3 Heavy Water Reactor is the newest design developed by AECL CANDU. It has set as a major objective, the achievement of significant reductions in both cost and schedule over previous designs. The basic construction strategy is to incorporate extensive modularization of the plant in order to parallel the civil and mechanical installation works. This results in a target 38 month construction schedule from first concrete to in-service compared to 68 months for the Wolsong-1 CANDU 6 actually achieved and the 54 months envisaged for an improved CANDU 6. This paper describes the module concepts that have been developed and explains how they contribute to the overall construction program and achieve the desired cost and schedule targets set for the CANDU 3. (author). 7 figs, 2 tabs.

**34016** (IWGFPT–37, pp. 124-135) **Hot cell examination of corrosion films on zirconium alloys using infrared spectroscopy, impedance and anodization techniques.** Ramasubramanian, N. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); Ling, V.C.; Schankula, M.H.; Chenier, R.J. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

Specialised equipment and techniques have recently been developed at Chalk River Laboratories to examine and characterize corrosion films on zirconium alloys. Infrared interferometry, in combination with impedance and anodization measurements, provides a non-destructive means of determining the total thickness of corrosion films, and the average and minimum thickness of the "non-porous" layer, respectively. The equipment for these measurements is installed in the Fuels and Materials Hot-Cell Facility at Chalk River and is being used for routine analysis of fuel rods and pressure tubes removed from CANDU reactors. Our experience has shown that this combination of spectroscopic and electrochemical techniques provides an excellent means of measuring film thickness and assessing the protective quality of corrosion films. (author). 9 refs, 11 figs, 1 tab.

**34017** (IWGFPT–37, pp. 143-148) **Pool-side inspection of spent reactor fuel in Argentina.** Sametband, M.J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)); Ruggirello, G.; Adelfang, P. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

Two pressurized heavy water reactors are being operated in Argentina: Atucha I, a KWU pressure vessel reactor with 360 MW, started in 1974, and Embalse, a CANDU-600 MW, since 1983. At Atucha I, a failed fuel detection and localisation system is being used, with a manifold valve which selects the water of each of the 230 fuel channels. and measures the gamma activity, but the operating experience showed the convenience of supplementing it with a sipping system. This is based on a gamma spectrometer which monitors the heavy water activity in the refuelling machine, enabling the detection of a failed fuel during its extraction or reshuffling. At both reactors pool-side examination equipment has been installed: visual inspection using telescopes and TV cameras. At Embalse, with a CANDU type fuel, the pool side inspection station includes the equipment for bundle dismantling which is being used for the examination of individual rods. For the underwater measurement of gamma activity of the spent fuel, a new solid state detector is now being tried: the miniature CdTe, which when well collimated has a reasonable resolution for the Cs 137 peak, is very compact and needs no cooling. Measurements of the gamma radiation in the vicinity of spent fuel at Atucha I using this detector have been performed and the method is now being tried specifically for the burnup measurement of individual rods. The experience with the sipping system at the refuelling machine, the installation for fuel dismantling, and the results of underwater gamma measurements with the CdTe detector are presented. 6 refs, 5 figs.

## 2105 Power Reactors, Breeding

*Refer also to citation(s) 33725, 34053, 34113, 34114, 34115, 34211, 34781, 35042*

**34018** (ANL/CP–72183) **LMR design concepts for transuranic management in low sodium void worth cores.** Hill, R.N. Argonne National Lab., IL (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-911001–23: International conference on fast reactor systems and fuel cycles, Kyoto (Japan), 27 Oct - 1 nov 1991). Order Number DE91018645. Source: OSTI; NTIS; INIS; GPO Dep.

The fuel cycle processing techniques and hard neuron spectrum of the Integral Fast Reactor (IFR) metal fuel cycle have favorable characteristics for the management of transuranics; and the wide range of breeding characteristics available in metal fuelled cores provides for flexibility in transuranic management strategy. Previous studies indicate that most design options which decrease the breeding ratio also show a decrease in sodium void worth; therefore, low void worths are achievable in transuranic burning (low breeding ratio) core designs. This paper describes numerous trade studies assessing various design options for a low void worth transuranic burner core. A flat annular core design appears to be a promising concept; the high leakage geometry yields a low breeding ratio and small sodium void worth. To allow flexibility in breeding characteristics, alternate design options which achieve fissile self-sufficiency are also evaluated. A self-sufficient core design which is interchangeable with the burner core and maintains a low sodium void worth is developed. 13 refs., 1 fig., 4 tabs.

**34019** (ANL/CP–73345) **The IFR modern nuclear fuel cycle.** Hannum, W.H. Argonne National Lab., IL (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9110212–1: 1991 American Society of Mechanical Engineers (ASME) annual meeting, San Diego, CA (United States), 7 Oct 1991). Order Number DE91018618. Source: OSTI; NTIS; INIS; GPO Dep.

Nuclear power is an essential component of the world's energy supply. The IFR program, by returning to fundamentals, offers a fresh approach to closing the nuclear fuel cycle. This closed fuel cycle represents the ultimate in efficient resource utilization and environmental accountability. 35 refs., 2 tabs.

**34020** (ANL/CP–73941) **Status of RBCB testing of LMR oxide fuel in EBR-II.** Strain, R.V. (Argonne National Lab., IL (United States)); Bottcher, J.H.; Gross, K.C.; Lambert, J.D.B.; Ukai, S.; Nomura, S.; Shikakura, S.; Katsuragawa, M. Argonne National Lab., IL (United States). [1991]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-911001–22: International conference on fast reactor systems and fuel cycles, Kyoto (Japan), 27 Oct - 1 nov 1991). Order Number DE91018642. Source: OSTI; NTIS; INIS; GPO Dep.

The status is given of the the American-Japanese collaborative program in Experimental Breeder Reactor 2 to determine the run-beyond-cladding-breach performance of $(UPu)O_2$ fuel pins for liquid-metal cooled reactors. Phase 1 of the collaboration involved eighteen irradiation tests over 1981–86 with 5.84-mm pins in 316 or D9 stainless steel. Emphasis in Phase 2 tests from 1989 onwards is with larger diameter (7.5mm) pins in advanced claddings. Results include delayed neutron and fission gas release data from breached pins, the impact of fuel-sodium reaction product formation on pin performance, and fuel and fission product contamination from failures. 13 refs, 1 fig., 4 tabs.

**34021** (INIS-mf–14003) **IWGFR specialists' meeting on properties of structural materials in liquid metal environment. Abstracts of the contributions.** Kernforschungszentrum Karlsruhe GmbH (Germany). 1991 19p. (CONF-9106290–: IWGFR/IAEA specialists' meeting on properties of structural materials in liquid metal environment, Karlsruhe (Germany), 18-20 Jun 1991). Order Number DE92711101. Source: OSTI; NTIS (US Sales Only); INIS.

This paper contains 16 abstracts to the following topics: 1. Creep-rupture behaviour of structural materials in liquid metal environment; 2. Behaviour of materials in liquid metal environments under off-normal conditions; 3. Fatigue and creep-fatigue of structural materials in liquid environment and 4. Crack propagation in liquid sodium. (MM).

**34022** (INIS-SU–272, pp. 93-105) **Effect of irradiation in design of LMFBR internals.** Tavassoli, A.A.; Cowan, A.; Vries, M.; Heesen, E.; Schmitt, R. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

A review related to irradiation effect on the reactor internals is given. Damages are evaluated by the number of displacements per atom and the quantity of the produced helium. A conclusion is made that the lower part structures operating at the temperatures of about 400 deg C remain serviceable under the doses of up to 2 dpa (or $10^{-2}$ p/m of He) despite the reduction of toughness and plasticity right at 0.8 dpa dose. More stringent demands are made on the core structures operating at 550 deg C, when the quantity of helium produced should not exceed $10^{-4}$ p/m. Importance of selecting welding materials and methods when producing the internals in which stainless austenitic steels (316 and 304 types) are mainly used, is underlined. 34 refs.; 1 fig.; 1 tab.

**34023** (IWGFPT–37, pp. 87-94) **Development of technology for mass post-irradiation examinations of BN reactor fuel pins.** Ivanov, V.B. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)); Dvoretskij, V.G.; Kanashov, B.A.; Neustroev, V.S.; Povstyanko, A.V.; Smirnov, V.P. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

A new material laboratory section has been put into operation in RIAR which comprises 7 shielded hot cells with investigation equipment designed for primary non-destructive examination of the full-scale fuel assemblies for power reactors including the BN-reactors as well. In order to develop the technology for mass examination of the BN-reactor fuel pins, measurements have been carried out with fuel pins from three standard BOR-60 fuel assemblies with the burnup up to 15% heavy atoms. The following parameters have been measured: fuel pin outside diameter, gas volume under the cladding, integrity of the cladding and fission product behaviour. Some results of the analysis of the experimental data bulk on the outside diameter are presented for selection and minimizing the number of fuel pins required for specimen preparation for further non-destructive examinations. A tendency to relative reduction of destructive testing is shown due to improvement of non-destructive methods. (author). 7 figs, 3 tabs.

**34024** (KFK–4798) **THIBO experiments. Experiments on thermohydraulically induced fuel rod oscillations in a sodium flow. Final report.** Bojarsky, E.; Deckers, H.; Lehning, H.; Piel, D.; Reiser, H.; Schmidt, L. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Materialforschung; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. May 1991. 33p. Order Number DE92714469. Source: OSTI; NTIS (US Sales Only); INIS.

The KNK II in Karlsruhe experienced fuel element damage which could not be traced back to hydraulically excited vibrations. Instead, some indications pointed to low-frequency fuel rod oscillations caused by temperature differences over the circumference of the fuel rod as a result of the high specific rod power and the clearance of fuel rods in their spacers. In 1988, specific experiments were started in the sodium loop of the IMF III to investigate this phenomenon (THIBO experiments). The rod movements were made visible and detected in a reproducible way. In 1989, another series of tests, THIBO II, have been run in a second test section. In this case, the cooling channel area was reduced so much that the thermohydraulic conditions very closely approximate those existing in the KNK II reactor. The experiments have shown that fuel rods may start moving already at relatively low sodium temperature increase and low partial loads, respectively, even if the rod clearance in the spacer was set to realistically low levels. (orig.).

**34025** (WHC-SA–1073) **Advanced liquid metal reactor fuel and blanket designs using HT9.** Bridges, A.E.; Waltar, A.E.; Leggett, R.D.; Baker, R.B.; Gneiting, B.C. Westinghouse Hanford Co., Richland, WA (United States). Aug 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-911001–6: International conference on fast reactor systems and fuel cycles, Kyoto (Japan), 27 Oct - 1 nov 1991). Order Number DE91017806. Source: OSTI; NTIS; INIS; GPO Dep.

This paper discusses the results of the Core Demonstration Experiment being irradiated in the US Department of Energy's Fast Flux Test Facility. The CDE clearly demonstrates that mixed-oxide fuel can achieve burnups in excess of 200 MWd/kgM and fast fluences in excess of 30 x $10^{22}$ n/cm$^2$ using the very low swelling ferritic-martensitic alloy, HT9. Supporting data from post-irradiation examination of the ACO-1 experiment, a related fuel test for the CDE, is reported and compared to the existing austenitic database. Additionally, the current status of a follow-on program to test metal fuel using HT9 is reviewed. 22 refs., 6 figs.

**34026** (WHC-SA–1088) **Fast Flux Test Facility fuel and test management: The first 10 years.** Bennett, R.A.; Bennett, C.L.; Campbell, L.R.; Dobbin, K.D.; Tang, E.L. Westinghouse Hanford Co., Richland, WA (United States). Jul 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-911001–10: International conference on fast reactor systems and fuel cycles, Kyoto (Japan), 27 Oct - 1 nov 1991). Order Number DE91017738. Source: OSTI; NTIS; INIS; GPO Dep.

Core design and fuel and test management have been performed efficiently at the Fast Flux Test Facility. No outages have been extended to adjust core loadings. Development of mixed oxide fuels for advanced liquid metal breeder reactors has been carried out successfully. In fact, the fuel performance is extraordinary. Failures have been so infrequent that further development and refinement of fuel requirements seem appropriate and could lead to a significant reduction in projected electrical busbar costs. The Fast Flux Test Facility is also involved in early metal fuel development tests and appears to be an ideal test bed for any further fuel development or refinement testing. 3 refs., 4 figs., 2 tabs.

## 2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

**34027** (PNL-SA–19728) **Testing of advanced ceramic fabric heat pipe for a Stirling engine.** Antoniak, Z.I.; Webb, B.J.; Bates, J.M. Pacific Northwest Lab., Richland, WA (United States). Sep

1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9109226–16: AIAA/NASA/OAI conference on advanced SEI technologies, Cleveland, OH (United States), 3-4 Sep 1991). Order Number DE92000142. Source: OSTI; NTIS; INIS; GPO Dep.

The development and application of Stirling engines for space power production requires concomitant development of an advanced heat rejection system. We are currently involved in the design, development, and testing of advanced ceramic fabric (ACF) water heat pipes for optimal heat rejection from the Stirling cycle without the use of hazardous working fluids such as mercury. Our testing to-date has been with a 200-$\mu$m thick titanium heat pipe utilizing Nextel ™ fabric as both the outer structural component and as a wick. This heat pipe has been successfully started up from a frozen condition against a negative 4 degree tilt (i.e., fluid return to evaporator was against gravity), with 75 W heat input, in ambient air. In a horizontal orientation, up to 100 W heat input was tolerated without experiencing dryout. 7 refs., 5 figs., 2 tabs.

## 2107 Regulation and Licensing

*Refer also to citation(s) 34161*

**34028** (FFU-rep–90-12) **Energy requirements in the new Federal Laender as a public interest in atomic energy law executive decisions.** Mez, L.; Wanke, A. Freie Univ. Berlin (Germany). Fachbereich Politische Wissenschaft. Oct 1990. 13p. (In German). (CONF-9010427–: All-German symposium on legal protection for the environment in the unified Germany, Wuerzburg (Germany), 12-13 Oct 1990). Order Number DE92714353. Source: OSTI; NTIS (US Sales Only); INIS.

By letters dated 24/4/90 and 4/5/90, the RWE Energie AG applied for declaring immediately executable, 'in the interest of the whole nation', the First Partial Licence for the nuclear power plant Muelheim-Kaerlich (KMK). RWE claimed in its applications that the outage of the KMK not only affected private-enterprise interests, but also had adverse effects on public interest in a safe, economy-priced and environmentally beneficial electricity supply. Summing up the study states that for reasons of technology and time it is impossible for the time being to supply the territory of the former German Democratic Republic with RWE electricity, that additional electricity supplies are not necessary anyway because of the sharp fall in energy consumption, and that consequently the RWE arguments pointing to the energy demand in the GDR as a public interest in the immediate execution of the Muelheim-Kaerlich nuclear power plant are untenable. (orig./HSCH).

**34029** (NUREG–0040-Vol.15-No.2) **Licensee contractor and vendor inspection status report: Quarterly report, April–June 1991: Volume 15, No. 2.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Reactor Inspection and Safeguards. Sep 1991. 281p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This periodical covers the results of inspections performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organization during the period from April 1991 through June 1991.

**34030** (NUREG–0540-Vol.13-No.7) **Title list of documents made publicly available, July 1–31, 1991: Volume 13, No. 7.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Sep 1991. 317p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This document is a monthly publication containing descriptions of information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes (1) docketed material associated with civilian nuclear power plants and other uses of radioactive materials, and (2) nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. The following indexes are included: Personal Author, Corporate Source, Report Number, and Cross Reference to Principal Documents.

**34031** (NUREG–0750-Vol.33-No.6) **Nuclear Regulatory Commission issuances: Volume 33, No. 6.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Jun 1991. 159p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judges (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

**34032** (NUREG–0750-Vol.34-No.1) **Nuclear Regulatory Commission issuances: Volume 34, No. 1.** Nuclear Regulatory Commission, Washington, DC (United States). Div. of Freedom of Information and Publications Services. Jul 1991. 153p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judges (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

**34033** (NUREG/CR–2000-Vol.10-No.8) **Licensee Event Report (LER) compilation for month of August 1991: Volume 10, No. 8.** Nuclear Regulatory Commission, Washington, DC (United States). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (United States). Sep 1991. 83p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/NSIC–200-Vol.10-No.8). Source: OSTI; NTIS; INIS; GPO.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 5.073 – Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System – Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule. The LER summaries in this report are arranged alphabetically by facility name and then chronologically by event date for each facility. Component, system, keyword, and component vendor indexes follow the summaries. Vendors are those identified by the utility when the LER form is initiated; the keywords for the component, system, and general keyword indexes are assigned by the computer using correlation tables from the Sequence Coding and Search System.

**34034** (NUREG/CR–4469-Vol.11) **Nondestructive examination (NDE) reliability for inservice inspection of light water reactors: Semi-annual report, April–September 1989: Volume 11.** Doctor, S.R. (Pacific Northwest Lab., Richland, WA (United States)); Good, M.S.; Green, E.R.; Heasler, P.G.; Simonen, F.A.; Spanner, J.C.; Taylor, T.T.; Vo, T.V. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Pacific Northwest Lab., Richland, WA (United States). Aug 1991. 48p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–5711-Vol.11). Source: OSTI; NTIS; INIS; GPO.

The Evaluation and Improvement of NDE Reliability for Inservice Inspection of Light Water Reactors (NDE Reliability) Program at the Pacific Northwest Laboratory was established by the Nuclear Regulatory Commission to determine the reliability of current inservice inspection (ISI) techniques and to develop recommendations that will ensure a suitably high inspection reliability. The objectives of this program include determining the reliability of ISI performed on the primary systems of commercial light-water reactors (LWRs);

using probabilistic fracture mechanics analysis to determine the impact of NDE unreliability on system safety; and evaluating reliability improvements that can be achieved with improved and advanced technology. A final objective is to formulate recommended revisions to ASME Code and Regulatory requirements, based on material properties, service conditions, and NDE uncertainties. The program scope is limited to ISI of the primary systems including the piping, vessel, and other components inspected in accordance with Section 6 of the ASME Code. This is a progress report covering the pro grammatic work from April 1989 through September 1989. 12 refs., 4 figs. 5 tabs.

## 2108 Economics

*Refer also to citation(s) 33982, 33988, 33989, 33992, 33993, 33994, 33995, 33996, 33997, 33998, 34015, 34018, 34019, 34252, 34253, 34260, 34373*

**34035** (CONF-910626–11) **The economic evaluation of emerging nuclear energy systems.** Williams, K.A. Oak Ridge National Lab., TN (United States). [1991]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 6. international conference on emerging nuclear energy systems: Monterey, CA (United States); 16-21 Jun 1991. Order Number DE91018245. Source: OSTI; NTIS; INIS; GPO Dep.

Most emerging nuclear energy systems are in the early phases of the research, development, design, and deployment life cycle and/or represent pioneer or first-of-a-kind projects; hence, the uncertainties associated with capital and life cycle costs are often considerable. The type of cost estimate prepared for a given system also depends heavily on the system's development/deployment status, and the cost projections prepared prior to the decision to construct a facility or system often do not incorporate all of the relevant uncertainties. The purpose of this paper is to survey the types of cost estimates typically prepared for selected nuclear systems at various stages of project development and to describe cost-engineering methodologies which may be used to produce more meaningful and realistic estimates. Examples utilizing nuclear technologies evaluated at Oak Ridge are used to illustrate these methods. Among the techniques considered are probabilistic cost-risk analysis, parametric cost models coupled to system/process performance and design models, and cost growth models based on historical experience with pioneer technologies. In addition to the above survey, the author discusses pitfalls and problems associated with early cost projections. A major premise is the fact that the standard "estimator's contingency" usually does not cover the myriad economic risks inherent to emerging energy-related or nuclear systems. 9 refs., 4 figs.

**34036** (DOE/EIA–0438(91)) **Commercial nuclear power 1991: Prospects for the United States and the world.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. Aug 1991. 142p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018522. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

This report presents historical data on commerical nuclear power in the United States, with projections of domestic nuclear capacity and generation through 2030. Country-specific projections of nuclear capacity and growth rates for electricity generation through 2010 for other countries in the world with free market economies (FME) are provided. Additionally, information is presented regarding operable reactors and those under construction in countries with regulated market economies (RME) and centrally planned economies (CPE). 11 figs., 33 tabs.

# 22 NUCLEAR REACTOR TECHNOLOGY

## 2201 Theory and Calculation

*Refer also to citation(s) 34099, 34100, 34108, 34209*

**34037** (EGG-M–90534) **Application of an integrated PC-based neutronics code system to criticality safety.** Briggs, J.B.; Nigg, D.W. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-910993–16: International conference on nuclear criticality (ICNC) safety, Oxford (United Kingdom), 9-13 Sep 1991). Order Number DE91018752. Source: OSTI; NTIS: INIS; GPO Dep.

An integrated system of neutronics and radiation transport software suitable for operation in an IBM PC-class environment has been under development at the Idaho National Engineering Laboratory (INEL) for the past four years. Nuclear cross-section data and resonance parameters are preprocessed from the Version 5 Evaluated Nuclear Data Files (ENDF/B-V) and supplied in a form suitable for use in a PC-based spectrum calculation and cross-section generation module. The cross-section module of the PC-based code system produces application-specific data libraries that can be used in various PC-based neutron transport and diffusion theory code modules. Some of the modules in the system are straightforward conversions of existing codes with a few improvements to allow more effective operation in the PC environment while other modules were specifically written for the PC code system. Four modules within the system are particularly useful for criticality safety applications: COMBINE/PC, a portable ENDF/B Version 5 neutron spectrum and cross-section generation program; KENO5A/PC, a three-dimensional Monte Carlo criticality module; ANISN/PC, a one-dimensional, discrete ordinates transport theory code; and DORT/PC, a two-dimensional, discrete ordinates transport theory code. A description of the codes and methods used in the analysis and the results of the benchmark critical experiments are presented in this paper. In general, excellent agreement was found between calculated and experimental results. 19 refs., 1 fig., 3 tabs.

## 2202 Components and Accessories

*Refer also to citation(s) 33800, 33971, 34029, 34046, 34047, 34058, 34099, 34100, 34118, 34119, 34120, 34121, 34123, 34125, 34126, 34127, 34129, 34130, 34207, 34450, 34806, 35331*

**34038** (EGG-EAST–9352) **Metal thermocouple correction methodology and evaluation (ECS-2c & ECS-2b test series).** Anderson, J.L.; Larson, T.K.; Condie, K.G. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jun 1991. 110p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018749. Source: OSTI; NTIS; GPO Dep.

The ECS-2 experiments were designed and performed to investigate downflow dryout in a heated ribbed vertical annulus. Subsequent experiments were performed in the same facility to investigate convective heat transfer under air/water downflow conditions. Under these conditions (> 40 K) azimuthal temperature variations were observed in the skin temperature measured using Type K thermocouples. The physical mechanisms causing the azimuthal variations in the thermocouples have not been identified. A methodology has been developed and evaluated for removing these effects. An uncertainty analysis has been performed to estimate the uncertainties resulting from application of the methodology. However, it is recommended that this methodology not be applied to the individual thermocouples unless a viable physical mechanism is identified to explain the observed thermocouple responses. 13 refs., 23 figs., 4 tabs.

**34039** (INIS-SU–272, pp. 5-14) **Material science, safety, reliability and economy of nuclear power plants.** Orlov, V.V. (Nauchno-Issledovatel'skij i Konstruktorskij Inst. Ehnergotekhniki, Moscow (USSR)); Kalinin, G.M. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Problems of materials science related to RBMK and WWER reactors, increased safety reactors and fusion reactors are analysed. Shape change of process channels and graphite stack under radiation effect due to radiation damage accumulation appearst to be the process, minimising the RBMK reactor life-time. A question of

the vessel radiation embrittlement occurs in relation to the vessel-type reactors. Characteristics of reactor materials with inherited safety and operating conditions of the main elements of the blanket and ITER fusion reactor first wall design are considered. 3 refs.; 3 figs.; 2 tabs.

**34040** (KURRI-TR–344) **Proceedings of the workshop on the cooling of advanced reactors.** Miyazaki, Keiji (Osaka Univ., Suita (Japan). Faculty of Engineering); Nishihara, Hideaki; Mishima, Kaichiro (eds.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1991. 186p. (In Japanese). (CONF-9001159–: Workshop on the cooling of advanced reactors, Kumatori (Japan), 18 Jan 1990). Order Number DE92704333. Source: OSTI; NTIS (US Sales Only); INIS.

Nuclear power has become to meet electric power demand by considerable proportion, and the peaceful utilization of atomic energy steadily returns scientific and technological results to the society. As to the problem of 'Heat removal from high performance nuclear reactors' taken up successively since the last year, there are the problem of heat transport in the reactors of new types as the source of energy supply, especially the pursuit from the viewpoint of the improvement of safety and reliability related to thermal engineering, and regarding nuclear reactors, the problem of the design and operation control of experimental facilities under the utmost condition in the core and its vicinity, not only the problem of reactors proper. Particularly regarding research reactors, precision has become to be demanded in addition to the safety and reliability thermally for various facilities. In the workshop of this year, the presenting of reports and discussion were carried out from the standpoint of thermal engineering on fast reactors and light water reactors of next generation, new research reactors and experimental facilities. (K.I.).

**34041** (RFP-Trans–504) **Process for the radioactive decontamination of an oil.** Augem, J.M. (Electricite de France Service National, Paris (France)). Rockwell International Corp., Golden, CO (United States). Rocky Flats Plant. Oct 1989. 14p. Translation of European Patent Application No. 0,252,826 A1, January 13, 1988. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91018404. Source: OSTI; NTIS; INIS; GPO Dep.

The object of the invention in this patent application is a process for the radioactive decontamination of an oil, which process is applicable in particular for the decontamination of oils used in nuclear installations. According to the invention, the oil is passed through a pulverulent material such as an earth in the presence of an acid. The pulverulent material can be placed beforehand on a filter or be mixed with the oil before filtration. If necessary, the oil is recycled through the filter until complete decontamination. The object is to remedy current disadvantages by proposing a low-cost process for radioactive decontamination of oils, which also permits an oil with an activity level of less than $3.7 \times 10^3$ Bq/m$^3$ to be obtained. According to the main characteristic of the process, this oil is passed through a pulverulent material in the presence of an acid. Preferably the pulverulent material is an earth containing diatoms or bentonites, and its particle size is smaller than 0.5 mm. As regards its mass, it is preferably between 0.5 and 5% of the mass of oil to be treated. The acid used can be hydrochloric, sulfuric or phosphoric acid, and its aqueous concentration is preferably greater than or equal to 70%. In the present description, the word "oil" must be taken in its most general sense, and it therefore designates both a lubricant and a lubricant base, such as a mineral, animal or vegetable oil. 1 fig.

**34042** (RFP-Trans–516) **Process for the separation of mixed ion exchange resins.** Kamei, K. (Mitsubishi Genshiryoku Kogyo K.K., Tokyo (Japan)); Kadoya, E. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. Jul 1990. 8p. Translation of Japanese Kokai Patent No. Hei 1-127049, May 19, 1989. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91018485. Source: OSTI; NTIS; INIS; GPO Dep.

This invention relates to a separation technique for mixed bed resins (mixed ion exchange resins) which are used for purification of the primary coolant (water) of nuclear reactors in nuclear power plants. The invention is comprised of a process for the separation of mixed ion exchange resins in which mixed ion exchange resins consisting of cation exchange resins and anion exchange resins are stirred in a separation solution to suspend the anion exchange resins alone as the upper phase of the aforementioned separation solution and the aforementioned suspended anion exchange resins are collected and separated, characterized in that an aqueous sugar solution with a sugar concentration of 1.03 g/cm$^3$ to 1.20 g/cm$^3$ is used as the separation solution.

## 2203 Fuel Elements

*Refer also to citation(s) 33999, 34000, 34002, 34003, 34004, 34005, 34006, 34007, 34013, 34014, 34016, 34017, 34023, 34785, 34786, 34787, 34788*

**34043** (IWGFPT–37, pp. 71-76) **Technical experience on PIE of high burnup fuel at RFEF/JAERI, Japan: Gas fluidity in fuel rod and defueling procedure.** Kikuchi, A. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Dept. of Reactor Fuel Examination); Amano, H.; Yamahara, T.; Itami, H. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

At Reactor Fuel Examination Facility (RFEF) in JAERI, the post irradiation examination (PIE) of high burnup fuel has been performed since April in 1989. In the progress of the examinations, several problems were encountered on PIE techniques, which had never been experienced for PIE of low burnup fuel. One of the problems is on the fluidity of FP gases within the fuel rod, which was noticed in the puncturing test. The other is on the removal of $UO_2$ pellet from the fuel rod (defueling), for the preparation of the cladding specimen for mechanical property tests. These problems are caused by the existence of contact between pellet and cladding (P/C contact) in the fuel rod with high burnup. To settle these problems, the experiment on gas fluidity and the technical development on defueling were carried out. By the former experiment, the gas conductance in the fuel rod with P/C contact was evaluated, and in the latter the defueling procedure was established successfully. In addition to the description of these main subjects, the paper presents the general introduction of RFEF and the characteristics of high burnup fuel, especially on P/C contact. (author). 15 figs, 3 tabs.

**34044** (IWGFPT–37, pp. 111-117) **Study of the feasibility of using matrix isolation spectroscopy to characterise the chemical forms of fission products evolving from heated irradiated fuel samples.** Gomme, R.A. (AEA Technology, Windscale (UK)); Green, R.A. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

This paper provides an introduction to the technique of matrix isolation spectroscopy, and highlights work which has been performed at AEA Technology, Windscale, and financed as an Underlying Research Project, to study the feasibility of installing appropriate equipment in a shielded facility, with a view to using the technique to characterise the chemical forms of species evolving from heated samples of irradiated fuel. (author). 7 figs.

## 2204 Control Systems

*Refer also to citation(s) 34108, 34198*

**34045** (HW–74095-Vol.2) **Hazards Summary Report: Volume 2, Process control and technical data, Hanford K Production Reactors.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 May 1963. 243p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018775. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This volume, the second of a series of three, is a part of an over-all Hazards Summary Report treating the Hanford K Production Reactors. A companion series, treating the six older Hanford Production Reactors is being issued as HW-74094-Vol.2. The purpose of this volume is to examine in detail the elements of reactor control and to provide the basic reactor physics and engineering data necessary for the analysis of reactor control and safeguards. Further, because no review of process control can be completed without considering the procedural means established to assure adequate attention to technical limitations, certain administrative aspects of process control are also discussed. 91 figs.

**34046** (IAEA-TECDOC–572, pp. 25-31) **Solid state track recorder pressure vessel surveillance neutron dosimetry at commercial nuclear power reactors.** Ruddy, F.H. (Westinghouse Science and Technology Center, Pittsburgh, PA (USA)); Seidel, J.G. International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

Solid State Track Recorder neutron dosimetry methods developed under the U.S. Nuclear Regulatory Commission Light Water Reactor Pressure Vessel Surveillance Dosimetry Improvement Program have been applied for pressure vessel surveillance dosimetry at commercial nuclear power reactors. More than 800 SSTR neutron dosimeters have been deployed at twelve different power reactors during twenty-two cycles of operation. More than 300 SSTR have been analyzed, and results with uncertainties in the 2-5% range have been generally obtained. Several new areas of application of SSTRs for radiation damage assessment for safe routine operation or extended life operation of power reactors are planned and these applications are discussed. (author). 14 refs.

**34047** (IAEA-TECDOC–572, pp. 33-43) **Benchmark referencing of ultra low-mass solid state track recorder neutron dosimeters in NBS standard neutron fields.** Ruddy, F.H. (Westinghouse Science and Technology Center, Pittsburgh, PA (USA)); McGarry, E.D. International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

Ultra low-mass fissionable deposit fabrication techniques developed for light water reactor pressure vessel surveillance dosimetry with solid state track recorders have been verified through irradiations in standard neutron fields at the National Institute of Standards and Technology (formerly NBS). Excellent agreement has been obtained between independent absolute calibrations of the fissionable deposits based on ultra low-mass radiochemical spiking techniques and on the response to a known neutron fluence in the standard neutron field. The status of and the results of standard irradiations carried out to date are described. (author). 7 refs, 4 figs, 2 tabs.

**34048** (JAERI-M–91-088) **A core management system for JRR-3.** Soyama, Kazuhiko (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Tsuruta, Harumichi; Ichikawa, Hiroki; Nemoto, Hiroyuki. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1991. 233p. (In Japanese). Order Number DE92713913. Source: OSTI; NTIS (US Sales Only); INIS.

Japan Research Reactor No.3 (JRR-3) was upgraded to the thermal output with 20 MW by replacing the core, cooling system and utilization facilities. It is a water moderated and cooled, pool type reactor using 20% enriched U · Alx fuel. A core management system for JRR-3 has been made. This code system can manage of reactivity, power distribution and burn up in consideration of the position of control rod, fuel arrangement and operation pattern. This report is the user's manual of this code system. (author).

**34049** (JAERI-M–91-096) **Experimental study of power distribution in FCA XV cores with half-inserted $B_4C$ control rod.** Oigawa, Hiroyuki (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Osugi, Toshitaka; Ohno, Akio; Satoh, Kunio; Tajima, Junichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 44p. (In Japanese). Order Number DE92713859. Source: OSTI; NTIS (US Sales Only); INIS.

Axial and radial power distributions were measured in FCA XV-1 and XV-2(95V) cores with half-inserted $B_4C$ control rod to improve the calculational accuracy of reactivity worth of $B_4C$ control rod. FCA XV-1 core has a zone type test region simulating a plutonium fueled HCLWR and XV-2(95V) core simulated a 95% voided state of coolant in HCLWR. Experimental results showed that reactivity worth and power depression by $B_4C$ control rod were closely related and there was a nearly linear relation between them in the range of present measurement. Therefore, the calculation which gives an accurate power depression was considered to give an accurate reactivity worth. The calculation using JENDL-2 and SRAC gave smaller reactivity worth and power depression than the experiment. The homogenization effect in cell calculation was considered as one of main causes of these underestimation and estimated to be about 5%. (author).

**34050** (JAERI-M–91-104) **Evaluation report on SCTF Core-III Test S3-22: Investigation of water break-through and core cooling behaviors under alternate ECC water delivery from hot legs to upper plenum during reflooding in PWRs with combined-injection type ECCS.** Okubo, Tsutomu (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Iguchi, Tadashi; Iwamura, Takamichi; Akimoto, Hajime; Ohnuki, Akira; Abe, Yutaka; Murao, Yoshio; Adachi, Hiromichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1991. 118p. Order Number DE92713916. Source: OSTI; NTIS (US Sales Only); INIS.

Two tests (Tests S3-20 and S3-22) were conducted with JAERI's Slab Core Test Facility (SCTF) Core-III in order to investigate water break-through and core cooling behaviors under the intermittent ECC water delivery from the hot legs to one location in the upper plenum and the alternate ECC water delivery to two locations in the upper plenum during reflooding, respectively. This report presents an analysis on Test S3-22 (the alternate case). Subcooled ECC water was injected alternately just above the upper core support plate above Bundles 7 and 8 and Bundles 3 and 4. The total injection rate from both injection ports was the same as that in SCTF Test S3-20 and Test S3-13. Analyzing the test data together with those of Tests S3-13 and S3-20 the following has been found: (1) Alternate break-through occurred immediately corresponding to the alternate ECC water injection except for one period, during which no break-through was observed. However, there observed a difference in break-through behavior that break-through was strong above the low power region, whereas weak above the high power region. (2) Although its break-through behavior was different, nearly the same core cooling as in the continuous or intermittent ECC water delivery case was observed except for the period around quench. (3) Around quench time, degraded core cooling comparing to the continuous or intermittent ECC water delivery case was observed. That is, quench time at the midplane level of the present test was 35 s later than in the continuous case. This is considered to result from decrease in core water inventory caused by water sealing at the cross-over leg. (J.P.N.).

**34051** (Juel–2467) **Measurement of neutron flux in the AVR.** Yamagishi, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Reactor Instrumentation Lab.); Wakayama, N.; Itoh, H.; Sakasai, K.; Brixy, H.; Oehmer, J.; Hecker, R.; Hantke, H. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Angewandte Werkstofforschung. Apr 1991. 45p. Order Number DE92714364. Source: OSTI; NTIS (US Sales Only); INIS.

The experiment to measure neutron flux distribution in the steam generator built above the reactor core of the AVR was carried out by using new type High Temperature In-core Fission Counter-chambers (HTICs) and Wide Range Neutron Flux Measuring Electronics (WRMEs) in December 1988. In the experiment, three HTICs were installed into the pipe of the steam generator. They operated properly to measure neutron flux from reactor start-up to full power without interference noise. Dynamic change of the neutron flux at each position of HTICs due to reactor power-change was able to be measured on real time from reactor start-up to full power. (orig./HP).

**34052** (Juel–2468) **Demonstration tests of the high temperature wide range neutron monitoring system in the AVR.** Yamagishi, H. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Reactor Instrumentation Lab.); Wakayama, N.; Itoh, H.; Sakasai, K.; Oehmen, J.; Brixy, H.; Hecker, R. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Angewandte Werkstoffforschung. Apr 1991. 42p. Order Number DE92714341. Source: OSTI; NTIS (US Sales Only); INIS.

A High Temperature Wide Range Neutron Monitoring System (HWNMS) was developed for HTGRs by JAERI. The special features of the HWNMS are as follows. The neutron sensor can be installed inside the pressure vessel of the HTGR. The maximum operating temperature of the neutron sensor is 800deg C. The HWNMS is designed to have low electric noises. The HWNMS provides the neutron flux monitoring and a reactor period indication from source range to power range. The HWNMS is designed to satisfy the requirements for the Post-Accident Monitor (PAM) of the HTGR. The performance test of the HWNMS was carried out in the research reactor JRR-4. The demonstration test was also performed in the actual high temperature gas-cooled reactor AVR. (orig./HP).

**34053** (ORNL/TM–11716) **Advanced automation concepts applied to Experimental Breeder Reactor-II startup: Annual report.** Berkan, R.C. (Tennessee Univ., Knoxville, TN (United States). Dept. of Nuclear Engineering); Upadhyaya, B.R.; Bywater, R.L.; Kisner, R.A. Oak Ridge National Lab., TN (United States). Aug 1991. 98p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91018316. Source: OSTI; NTIS; INIS; GPO Dep.

The major objective of this work is to demonstrate through simulations that advanced liquid-metal reactor plants can be operated from low power by computer control. Development of an automatic control system with this objective will help resolve specific issues and provide proof through demonstration that automatic control for plant startup is feasible. This paper presents an advanced control system design for startup of the Experimental Breeder Reactor-2 (EBR-2) located at Idaho Falls, Idaho. The design incorporates recent methods in nonlinear control with advanced diagnostics techniques such as neural networks to form an integrated architecture. The preliminary evaluations are obtained in a simulated environment by a low-order, valid nonlinear model. Within the framework of phase 1 research, the design includes an inverse dynamics controller, a fuzzy controller, and an artificial neural network controller. These three nonlinear control modules are designed to follow the EBR-2 startup trajectories in a multi-input/output regime. They are coordinated by a supervisory routine to yield a fault-tolerant, parallel operation. The control system operates in three modes: manual, semiautomatic, and fully automatic control. The simulation results of the EBR-2 startup transients proved the effectiveness of the advanced concepts. The work presented in this paper is a preliminary feasibility analysis and does not constitute a final design of an automated startup control system for EBR-2. 14 refs., 43 figs.

## 2205 Environmental Aspects

*Refer also to citation(s) 33746, 33982, 35004, 35033, 35034, 35035, 35038, 35039, 35040, 35042, 35043, 35045, 35046, 35047, 35048, 35049, 35050*

**34054** (CONF-9109271–1) **Iodine chemical forms in LWR severe accidents.** Weber, C.F.; Beahm, E.C.; Kress, T.S. Oak Ridge National Lab., TN (United States). [1991]. 17p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From 3. Committee for the Safety of Nuclear Installations (CSNI) workshop on iodine chemistry in reactor safety; Tokai-mura (Japan); 11-13 Sep 1991. Order Number DE91018854. Source: OSTI; NTIS; INIS; GPO Dep.

Calculated data from seven severe accident sequences in light water reactor plants were used to assess the chemical forms of iodine in containment. In most of the calculations for the seven sequences, iodine entering containment from the reactor coolant system was almost entirely in the form of CsI with very small contributions of I or HI. The largest fraction of iodine in forms other than CsI was a total of 3.2% as I plus HI. Within the containment, the CsI will deposit onto walls and other surfaces, as well as in water pools, largely in the form of iodide ($I^-$). The radiation-induced conversion of $I^-$ in water pools into $I_2$ is strongly dependent on pH. In systems where the pH was controlled above 7, little additional elemental iodine would be produced in the containment atmosphere. When the pH falls below 7, it may be assumed that it is not being controlled and large fractions of iodine as $I_2$ within the containment atmosphere may be produced. 17 refs., 5 tabs.

**34055** (EUR–12990, pp. 69-84) **Integrated measurement and information system for the surveillance of environmental radioactivity (IMIS) in the Federal Republic of Germany.** Bayer, A. (Bundesamt fuer Strahlenschutz, Neuherberg (DE). Inst. fuer Strahlenhygiene); Dehos, R.; Kaul, A. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling.* 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

The Precautionary Radiological Protection Act passed by the German Parliament has laid the foundation for the Integrated Measurement and Information System for the Surveillance of the Environmental Radioactivity (IMIS) which is currently in preparation. The task of this system is the continuous surveillance of the environmental radioactivity. With this it provides in the case of events that are potentially of significant radiological impact the informative basis for appropriate measures which can be introduced by competent authorities. The requirements to be met by the measurement systems and the environmental fields which are controlled by the various networks are described, as well as the various tasks which have to be fulfilled by the institutions involved in this system. The requirements to be met by the data processing system which makes the fast information technically possible are explained as well as the different modes of operation of the total system.

**34056** (HW–9191-Del.) **Hanford Works monthly report, February 1948.** Hanford Works, Richland, WA (United States). 23 Mar 1948. 250p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018763. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document discusses activities during the month of February 1948. Production requirements were met by operating the D and F Piles at 275 MV, the B Pile remaining in stand-by condition. The first severe occurrence of a stuck slug in a process tube occurred in the D Pile on February 2. Approximately three days were required to remove this slug. The operating time efficiency was 68.4%, caused by the above difficulty and scheduled outages for normal discharge of metal and repairs to Van Stone flanges of the process tubes. Production facilities in the 300 Area were placed on a partial two-shift basis on February 2, 1948 to meet anticipated demands for increased production. The new metal casting facilities in the 300 Area were placed in operation in February. Forty batches were started through the Canyon Buildings and forty-two were completed through the Isolation Building. There was one major injury during February. The plant safety record at month-end was twenty-three days. Effective February 1, Maintenance Engineering Section will assume the status of a separate Works Engineering Department, to be known as Project Engineering Department. This Department will handle plant improvement projects originating from plant operations.

**34057** (HW–74095-Vol.3) **Hazards Summary Report: Volume 3, Description of the 100-KE and the 100-KW production**

**reactor plants.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Apr 1963. 147p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018780. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The purpose of this Hazards Summary Report, HW-74095 Volume 3, is to present a comprehensive physical description of the 100-KE and 100-KW Production Reactor Plants at Hanford. This volume is part of an over-all Hazards Summary Report, and complements Volumes 1 and 2. A similar Hazards Summary Report, HW-74094, is being issued for the six older production reactor plants at Hanford. The term "Production Reactor Plant" is defined as a Hanford Production Reactor plus its associated water supply and effluent water disposal facilities. 56 figs.

34058 (RFP-Trans–503) **Process and device for cleaning of water-containing machine oil from nuclear power plants.** Kupfer, K. (MTT Metalltrenntechnik fuer Nuklearentsorgung GmbH, Mosbach (Germany)). Rockwell International Corp., Golden, CO (United States). Rocky Flats Plant. Oct 1989. 13p. Translation of German Patent Application No. 3,600,358 A1, 16 July 1987. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91018406. Source: OSTI; NTIS; INIS; GPO Dep.

The radioactive contaminants produced in water-containing machine oil in plants operated with nuclear power are removed from the contaminated machine oil by adsorption on water-adsorbing material. This document discusses this process. 3 figs., 1 tab.

34059 (TVA/WR/AB–91/5) **Chickamauga Reservoir 1990 fisheries monitoring cove rotenone results.** Kerley, B.L. Tennessee Valley Authority, Norris, TN (United States). Div. of Water Resources. Jun 1991. 57p. Sponsored by Tennessee Valley Authority, Knoxville, TN (United States). Order Number DE91015963. Source: OSTI; NTIS.

Based on cove rotenone sampling from 1970 through 1990, total fish biomass in Chickamauga Reservoir has remained relatively stable. Although changes in abundance have been documented for some species, most variation appears related to aquatic macrophyte density shifts, drought-induced conditions, cyclic fluctuations, and occasional flood conditions. Operation of SQN does not appear to have affected the fish population of Chickamauga Reservoir. 18 refs., 1 fig., 31 tabs.

## 2206 Research, Test, and Experimental Reactors

*Refer also to citation(s) 33991, 34026, 34048, 34049, 34064, 34113, 34122, 34208, 34211*

34060 (ANL/CP–71328) **Code validation with EBR-II test data.** Herzog, J.P.; Chang, L.K.; Dean, E.M.; Feldman, E.E.; Hill, D.J.; Mohr, D.; Planchon, H.P. Argonne National Lab., IL (United States). [1991]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-911014–1: International conference on dynamics and control in nuclear power stations, London (United Kingdom), 22-24 Oct 1991). Order Number DE91018576. Source: OSTI; NTIS; GPO Dep.

An extensive system of computer codes is used at Argonne National Laboratory to analyze whole-plant transient behavior of the Experiment Breeder Reactor 2. Three of these codes, NATDEMO/HOTCHAN, SASSYS, and DSNP have been validated with data from reactor transient tests. The validated codes are the foundation of safety analyses and pretest predictions for the continuing design improvements and experimental programs in EBR-2, and are also valuable tools for the analysis of innovative reactor designs. 29 refs., 6 figs.

34061 (JAERI-M–91-083) **An explication of the Graphite Structural Design Code of core components for the High Temperature Engineering Test Reactor.** Iyoku, Tatsuo (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Ishihara, Masahiro; Toyota, Junji; Shiozawa, Shusaku. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1991. 36p. (In Japanese). Order Number DE92713918. Source: OSTI; NTIS (US Sales Only); INIS.

The integrity evaluation of the core graphite components for the High Temperature Engineering Test Reactor (HTTR) will be carried out based upon the Graphite Structural Design Code for core components. In the application of this design code, it is necessary to make clear the basic concept to evaluate the integrity of core components of HTTR. Therefore, considering the detailed design of core graphite structures such as fuel graphite blocks, etc. of HTTR, this report explicates the design code in detail about the concepts of stress and fatigue limits, integrity evaluation method of oxidized graphite components and thermal irradiation stress analysis method etc. (author).

34062 (JAERI-M–91-087) **Reactor neutron-induced prompt gamma-ray analysis: Review and research program at the neutron guide beam of JRR-3 (upgraded).** Yonezawa, Chushiro (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Hoshi, Michio. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1991. 50p. (In Japanese). Order Number DE92704178. Source: OSTI; NTIS (US Sales Only); INIS.

Reactor neutron-induced prompt gamma-ray analysis is reviewed and compared with conventional neutron activation analysis. The facilities mainly used for analytical chemistry are classified into three categories: internal, beam and guide beam types. The analytical sensitivity and detection limits of each type are compared and then several kinds of applications are presented. Finally, an apparatus installed in the cold and thermal neutron guide beam lines of JRR-3 (upgraded) is described together with research program using it. (author) 64 refs.

34063 (JAERI-M–91-111) **Analysis of irradiation-induced stresses in coating layers of coated fuel particles for the High Temperature Engineering Test Reactor (HTTR).** Hayashi, Kimio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kikuchi, Teruo; Fukuda, Kousaku; Sato, Sadao; Toyota, Junji; Shiozawa, Shusaku; Sawa, Kazuhiro; Kashimura, Satoru. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1991. 46p. (In Japanese). Order Number DE92713933. Source: OSTI; NTIS (US Sales Only); INIS.

Irradiation-induced stresses in coating layers of coated fuel particles were analyzed by the MICROS-2 code for the fuels of the High Temperature Engineering Test Reactor (HTTR) under its operating conditions. The analyses were made on the standard core fuel (A-type) and the test fuels comprising the advanced SiC-coated particle fuel (B-1 type) and the ZrC-coated particle fuel (B-2 type). For the B-1 type fuel, the stresses were relieved due to the thicker buffer and SiC layers than for the A type fuel. The slightly decreased thickness of the fourth layer for the B-1 type than for the A type fuel had no significant effect on the stresses. As for the B-2 type fuel, almost the same results as for the B-1 type were obtained under an assumption that the ZrC layer as well as the SiC layer undergoes negligible dimension change within the analysis conditions. The obtained results indicated that the B-1 and B-2 type fuels are better than the A type fuel in terms of integrity against the irradiation-induced stresses. Finally, research subjects for development of the analysis code on the fuel behavior are discussed. (author).

## 2207 Plutonium and Isotope Production Reactors

*Refer also to citation(s) 34045, 34056, 34057, 34114, 34131, 34133, 34134, 34135, 34136, 34137, 34138, 34139, 34140, 34141, 34142, 34143, 34144, 34145, 34146, 34147, 34148, 34149, 34150, 34151, 34152, 34153, 34154, 34155, 34156, 34157, 34158, 34159, 34160, 34194, 34195, 34196, 34197, 34198, 34199*

34064 (ANL/RERTR/TM–17) **The Ford Nuclear Reactor demonstration project for the evaluation and analysis of low enrichment fuel: Final report.** Kerr, W. (Michigan Univ., Ann Arbor, MI (United States)); King, J.S.; Lee, J.C.; Martin, W.R.; Wehe, D.K. Argonne National Lab., IL (United States); Michigan Univ., Ann Arbor, MI (United States). Jul 1991. 362p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE91017713. Source: OSTI; NTIS; INIS; GPO Dep.

The whole-core LEU fuel demonstration project at the University of Michigan was begun in 1979 as part of the Reduced Enrichment

Research and Test Reactor (RERTR) Program at Argonne National Laboratory. An LEU fuel design was selected which would produce minimum perturbations in the neutronic, operations, and safety characteristics of the 2-MW Ford Nuclear Reactor (FNR). Initial criticality with a full LEU core on December 8, 1981, was followed by low- and full-power testing of the fresh LEU core, transitional operation with mixed HEU-LEU configurations, and establishment of full LEU equilibrium core operation. The transition from the HEU to the LEU configurations was achieved with negligible impact on experimental utilization and safe operation of the reactor. 78 refs., 74 figs., 84 tabs.

**34065** (DUN–5000-Suppl.1) **Tube 3560-KW flow stoppage incident Corrective Action Task Force charter: Supplement 1.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 23 Jun 1968. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000544. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Short communication. HANFORD PRODUCTION REACTORS/reactor operation; HANFORD PRODUCTION REACTORS/loss of flow; LOSS OF FLOW/emergency plans; REMEDIAL ACTION; PLANNING; ADMINISTRATIVE PROCEDURES; MANAGEMENT

**34066** (HEW–7096-Del.) **Hanford Engineer Works monthly report, June 1947.** Hanford Works, Richland, WA (United States). 15 Jul 1947. 173p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018564. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document discusses activities at Hanford Engineer works during the month of June 1947. The power levels of the Piles at 100 D and 100 F were maintained at 250 MW and 200 MW respectively. The operating time efficiency was 88.8. Thirty-one batches were started in the Canyon Buildings and thirty-two were delivered from the Isolation Building. There were no major injuries during June and as of the end of the month, the plant had operated fifty-five consecutive injury-free days. Project approvals have been secured for the additions to Columbia High School and Jefferson Grade School, also for the construction of five hundred housing units. Steps are being taken to select a contractor to handle the approved work and it is expected that contracts will be negotiated in less than thirty days. Architectural engineers have been selected for the work on commercial facilities for the Village. This work is proceeding and will in general be completed in ninety days. The preliminary planning for the major construction program has now progressed to the point where definite plans can be made for the various phases of the program. Definite steps will be taken toward the integrating of the various parts of the program; that is, between the Village and the Plant.

**34067** (HEW–7283-Del.) **Hanford Engineer Works monthly report, July 1947.** Hanford Works, Richland, WA (United States). 13 Aug 1947. 187p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018766. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Engineer Works during the month of July 1947. (FI)

**34068** (HEW–7378-Del.) **Hanford Engineer Works technical progress letter No. 164, August 17–August 23, 1947.** Hanford Works, Richland, WA (United States). 28 Aug 1947. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000303. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Hanford Engineer Works technical department during the time period of August 17 through August 23, 1947. (FI)

**34069** (HEW–7504-Del.) **Hanford Engineering Works monthly report, August, 1947.** Hanford Works, Richland, WA (United States). 17 Sep 1947. 183p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018767. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Engineer Works during the month of August 1947.

**34070** (HEW–7565-Del.) **Hanford Engineer works technical progress letter No. 167, September 7 through September 13.** Hanford Works, Richland, WA (United States). 18 Sep 1947. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018903. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This progress report from Hanford Engineer Works for September 7 –13, 1947 describes efforts in physics and engineering. Topics include fuel rods. buildings, redox development, stack disposal and metallurgy. (GHH)

**34071** (HW–7-6184-Del.) **Hanford Engineering Works monthly report, April 1947.** Hanford Works, Richland, WA (United States). 12 May 1947. 168p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018768. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Engineer Works during the month of April 1947. (FI)

**34072** (HW–7795-Del.) **Hanford Works monthly report, September 1947.** Hanford Works, Richland, WA (United States). 15 Oct 1947. 200p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018770. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works during the month of September 1947. (FI)

**34073** (HW–7997-Del.) **Hanford Works monthly report, October 1947.** Hanford Works, Richland, WA (United States). 18 Nov 1947. 207p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018771. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works during the month of October 1947. (FI)

**34074** (HW–8267-Del.) **Hanford Works monthly report, November 1947.** Hanford Works, Richland, WA (United States). 17 Dec 1947. 213p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018756. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works during the month of November 1947. (FI)

**34075** (HW–8438-Del.) **Hanford Works monthly report, December 1947.** Hanford Works, Richland, WA (United States). 21 Jan 1948. 234p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018762. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works during the month of December 1947. (FI)

**34076** (HW–9201-Del.) **Hanford Works technical progress letter No. 193, March 7–March 13, 1948.** Hanford Works, Richland, WA (United States). 18 Mar 1948. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000320. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Hanford Works technical department during the time period of March 7 through March 13, 1948. (FI)

**34077** (HW–9595-Del.) **Hanford Works monthly report, March 1948.** Hanford Works, Richland, WA (United States). 26 Apr 1948. 238p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018764. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document discusses activities during the month of March 1948. Production requirements were met by operation of the D and F Piles at 275 MV, the B Pile remaining in stand-by condition. In the 300 Area, lead dip canning of Alpha rolled metal instead of gamma extruded metal was started on a production basis during the month. Thus far irradiated Alpha rolled lead dipped material has not shown any appreciable blistering tendencies. Thirty-six batches were started in the Canyon Buildings and thirty-seven were completed through the Isolation Building. Although the very large contaminated particles which were being discharged from the stacks of the 200 Areas have been essentially eliminated by the

replacement of the iron duct work and fans of the exhaust system. the problem of the smaller, mist-like particles still exists. This problem of removal of these small particles is being actively pursued by installation of special filters and scrubbers in the exhaust system. There were no major injuries during March and the plant safety record at month-end was fifty-four days. The Reactor Development Group met in Hanford to discuss present operating problems, the design of new Piles and the direction which should be taken for work on future piles. The General Electric Company's House of Magic was in Richland this month. Fifteen scheduled performances were given with approximately 12,000 persons attending.

**34078** (HW–9708) **Hanford Works technical progress letter No. 200, April 25–May 1, [1948].** Hanford Works, Richland, WA (United States). 6 May 1948. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000496. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Hanford Works technical department during the time period of April 25 through May 1, 1948. (FI)

**34079** (HW–9910-Del.) **Hanford Works technical progress letter No. 203, May 16–May 22, [1948].** Hanford Works, Richland, WA (United States). 27 May 1948. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018904. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report contains information for activities at the Hanford Works for May 16th through May 22nd, 1948. Work in pile technology, separations, and metallurgy & control areas will be discussed. (JL)

**34080** (HW–10166-Del.) **Hanford Works monthly report, May, 1948.** Hanford Works, Richland, WA (United States). 21 Jun 1948. 262p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018781. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works during the month of May 1948. (FI)

**34081** (HW–10395-Del.) **Process and operating improvements for the second quarter of 1948.** Gross, C.N. Hanford Works, Richland, WA (United States). 12 Jul 1948. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000321. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a detailed list of the principal improvements accomplished in the 100, 200, and 300 Areas during the second quarter of 1948.

**34082** (HW–10657-Del.) **Hanford Works technical progress letter No. 213, July 25, 1948–July 31, 1948.** Hanford Works, Richland, WA (United States). 5 Aug 1948. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000322. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Hanford Works technical divisions during the time period of July 25 through July 31, 1948. (FI)

**34083** (HW–12121-Del.) **Hanford Works technical progress letter No. 236, January 2–January 8, [1949].** Hanford Works, Richland, WA (United States). 13 Jan 1949. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018905. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report contains information for activities at the Hanford Works for January 2nd through January 8th, 1949. Work in pile technology, separations, and metallurgy & control areas are discussed. (JL)

**34084** (HW–12736-Del.) **Hanford Works technical progress letter No. 245, March 6–March 12, [1949].** Hanford Works, Richland, WA (United States). 17 Mar 1949. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018906. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report contains information from several of the Hanford Works' divisions. Work from March 6 through March 12, 1949 is reported for the physics, engineering, P-10 project, 200 area plant assistance, and metallurgy & control areas. (JL)

**34085** (HW–12799-Del.) **Hanford Works technical progress letter No. 246, March 13–March 19, 1949.** Hanford Works, Richland, WA (United States). 24 Mar 1949. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000323. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Hanford Works technical divisions during the time period of March 13 through March 19, 1949. (FI)

**34086** (HW–13793-Del.) **Hanford Works monthly report, June 1949.** Hanford Works, Richland, WA (United States). 18 Jul 1949. 275p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018776. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document discusses activities at the Hanford Works during the month of June 1949. (FI)

**34087** (HW–14043-Del.) **Hanford Works monthly report, July 1949.** Hanford Works, Richland, WA (United States). 18 Aug 1949. 272p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018777. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works during the month of July 1949. (FI)

**34088** (HW–14275-Del.) **Hanford Works technical progress letter No. 259, August 11–August 25, 1949.** Hanford Works, Richland, WA (United States). 31 Aug 1949. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018907. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report contains information for activities at the Hanford Works for the period of August 11th through August 25th, 1949. Work in separations, pile technology, and metallurgy & control areas will be discussed. (JL)

**34089** (HW–14338-Del.) **Hanford Works monthly report, August 1949.** Hanford Works, Richland, WA (United States). 19 Sep 1949. 284p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018567. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works for the month of August 1949. (FI)

**34090** (HW–14596-Del.) **Hanford Works monthly report, September 1949.** Hanford Works, Richland, WA (United States). 18 Oct 1949. 279p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018778. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works during the month of September 1949. (FI)

**34091** (HW–14916-Del.) **Hanford Works monthly report, October 1949.** Hanford Works, Richland, WA (United States). 18 Nov 1949. 297p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018779. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works during the month of October 1949. (FI)

**34092** (HW–15224-Del.) **Hanford Works technical progress letter No. 265, November 11–November 25, [1949].** Hanford Works, Richland, WA (United States). 1 Dec 1949. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018908. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report contains information from activities at the Hanford Works for the time period of November 11th through November

25th, 1949. Work in pile technology, separations, and metallurgy & control areas are discussed. (JL)

**34093** (HW–15267-Del.) **Hanford Works monthly report, November 1949.** Hanford Works, Richland, WA (United States). 16 Dec 1949. 299p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018782. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities for the Hanford Works for the month of November 1949. (FI)

**34094** (HW–15686-Del.) **Hanford Works technical progress letter No. 268, December 26, [1949]–January 10, [1950].** Hanford Works, Richland, WA (United States). 16 Jan 1950. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018909. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report contains information from activities at the Hanford Works for the period of December 26th through January 10th, 1950. Work from the pile technology, separations, and technical services areas are reported. (JL)

**34095** (HW–17056-Del.) **Hanford Works monthly report, February 1950.** Hanford Works, Richland, WA (United States). 20 Mar 1950. 321p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018772. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Works during the month of February 1950. (FI)

**34096** (HW–17679) **Technical progress letter for April 1950.** Hanford Works, Richland, WA (United States). 4 May 1950. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000325. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities for the Hanford Works technical divisions for the month of April 1950. (FI)

**34097** (HW–19301-Del.) **AEC research and development report: Atomic weapon data: Technical progress letter for October 1950.** Hanford Works, Richland, WA (United States). 6 Nov 1950. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000327. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Hanford Works technical divisions for the month of October 1950. (FI)

**34098** (HW–20381-Del.) **Technical progress letter for February 1951.** Hanford Works, Richland, WA (United States). 6 Mar 1951. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000328. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Hanford Works technical divisions during the month of February 1951. (FI)

**34099** (HW–24832-Del.) **Technical activities report, June 1952: Pile Physics.** Dickeman, R.L. Hanford Works, Richland, WA (United States). 10 Jul 1952. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000338. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the activities of the Hanford Works pile physics group during the month of June 1952. (FI)

**34100** (HW–25052-Del.) **Technical activities report on pile physics.** Dickeman, R.L. Hanford Works, Richland, WA (United States). 10 Aug 1952. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000339. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the Hanford Works pile technology unit for the month of June 1952. (FI)

**34101** (HW–40560-Del.) **Variables in Hanford reactor production after water plant expansion.** Reid, R.W. Hanford Works, Richland, WA (United States). 27 Dec 1955. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000346. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Modifications to the B, D, and DR Reactors to provide a thirty per cent increased water flow are currently in progress. To examine the variables of reactor operation after modifications, an equation has been developed which describes the total production of a modified reactor in terms of goal exposure and tube power. Specific treatment is given only to an old reactor. A complete reactor production analysis would involve separate consideration of the K's, H and C Reactors. It is expected that these cases will have enough similarity to the one case considered so that valid, broad conclusions can be drawn. Determination of exact present and future goal exposures requires a more detailed analysis.

**34102** (HW–43556) **Examination of slugs from ruptured front pigtail incident at C-Pile.** Boyd, C.L. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 23 Jul 1956. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000344. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Failure of the front pigtail-crossheader connection on tube 3158 at C Pile resulted in operation of the tube without water flow for a short period of time. Shortly, after the pile scrammed, a reverse flow of water (the estimated quantity was a few gallons per minute) was observed coming from the tube pigtail. This flow is believed to have originated from the rear crossheader. Heat transfer calculations based upon assumed instantaneous loss of cooling water, indicated that high temperatures possibly existed in the tube. 3 refs., 18 figs., 4 tabs.

**34103** (HW–60918) **Irradiation Processing Department monthly record report, June 1959.** Hanford Works, Richland, WA (United States). 22 Jul 1959. 113p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (HAN–72947). Order Number DE92000534. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of June 1959. Topics discussed include research and engineering operation, production and reactor operation, facilities engineering, employee relations, financial operation, and new production reactor operation. (FI)

**34104** (HW–62052) **Operational interruption, B Reactor, September 12, 1959.** Maguire, A.R. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 22 Sep 1959. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (HAN–73609). Order Number DE92000583. Source: OSTI; NTIS (US Sales Only); GPO Dep.

B Reactor was scrammed on September 10 and again on September 12 by panellit trips. Subsequent investigations revealed the scrams were caused by small pieces of neoprene in an orifice screen. Extensive checks following the September 12 scram revealed pieces of neoprene in all seven near-side process water header basket screens, in all crossheader screens, and in three process tube orifice screens. The source of the neoprene was found to be a deteriorated curtain seal in the No. 4 process water storage tank, 190 Building. A portion of this seal had fallen into the storage tank and become dispersed throughout the downstream process water supply system. Total outage time required to clean and flush the process water supply system and resume reactor operation was 88.6 hours. Of the total outage time, approximately 40 hours were utilized in the performance of necessary project and maintenance work in the discharge area, which otherwise would have required outage time at later dates.

**34105** (HW–62900) **Irradiation Processing Department monthly record report November, 1959.** Hanford Works, Richland, WA (United States). 22 Dec 1959. 118p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (HAN–74275). Order Number DE92000535. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of November 1959. Topics discussed are manufacturing operations, research and engineering, facilities engineering, relations practices operations, financial operation, and new production reactor operation. (FI)

**34106** (HW–67954) **Hanford Laboratories Operation, monthly activities report, December 1960.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Jan 1961. 170p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000578. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document is the monthly activities report for December 1960, from the Hanford Laboratories Operation. It includes budget and schedule information, as well as specific progress reports from the following Research and Development Operations: Reactor and Fuels; Chemical Research and Development; Physics and Instrument Research and Development; Biology; and Programming. Also included are reports from Technical and Other Services, and a listing of Supporting Functions occurring during this time period. Appendices provide more detailed information in each of these areas. 4 tabs. (MHB)

**34107** (HW–73473) **Irradiation Processing Department Monthly report April, 1962.** Hanford Works, Richland, WA (United States). 11 May 1962. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (HAN–81834-Del.). Order Number DE92000536. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities of the irradiation processing department during the month of April 1962. Topics of discussion are manufacturing operations, research and engineering, facilities engineering, the new production reactor project, and a listing of reports issued, trips, and visitors. (FI)

**34108** (HW–74094-Vol.2) **Process control and technical data: Six oldest Hanford production reactors: Hazards summary report, Volume 2.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 May 1963. 284p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (HAN–85233). Order Number DE92000495. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This volume, the second of a series of three, is a part of an over-all Hazards Summary Report treating the six older Hanford production reactors (B, C, D, DR, F and H Reactors). A companion series, treating the Hanford K Production Reactors is being issued as HW-74095 Vol. 2. The purpose of this volume is to examine in detail the elements of reactor control and to provide the basic reactor physics and engineering data necessary for the analysis of reactor control and safeguards. In this way, the work supports safety analyses and hazards evaluations reported in Volume 1; and is in turn supported by Volume 3, which provides a comprehensive physical description of the production reactor plants under discussion. Further, because no review of process control can be completed without considering the procedural means established to assure adequate attention to technical limitations, certain administrative aspects of process control are also discussed.

**34109** (HW–75451) **Irradiation Processing Department monthly report, October 1962.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Nov 1962. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (HAN–83451-Del.). Order Number DE92000522. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document discusses activities of the irradiation processing department during the month of October 1962. Topics include Manufacturing operations, Research and Engineering activities, Facilities engineering, financial information, and a listing of reports, trips, and visitors. (FI)

**34110** (HW–76596) **Hanford Laboratories monthly activities report, February, 1963.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Mar 1963. 194p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000586. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details activities at the Hanford Laboratories during the month of February 1963. (FI)

## 2208 Propulsion Reactors

**34111** (LA-UR–91-3100) **Innovative nuclear thermal propulsion technology evaluation: Results of the NASA/DOE Task Team study.** Howe, S. (Los Alamos National Lab., NM (United States)); Borowski, S.; Motloch, C.; Helms, I.; Diaz, N.; Anghaie, S.; Latham, T. Los Alamos National Lab., NM (United States). [1991]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9110217–2: 42. International Aeronautical Federation Congress (IAEFC), Montreal (Canada), 7-11 Oct 1991). Order Number DE92000176. Source: OSTI; NTIS; INIS; GPO Dep.

In response to findings from two NASA/DOE nuclear propulsion workshops held in the summer of 1990, six task teams were formed to continue evaluation of various nuclear propulsion concepts. The Task Team on Nuclear Thermal Propulsion (NTP) created the Innovative Concepts Subpanel to evaluate thermal propulsion concepts which did not utilize solid fuel. The Subpanel endeavored to evaluate each of the concepts on a "level technological playing field," and to identify critical technologies, issues, and early proof-of-concept experiments. The concepts included the liquid core fission, the gas core fission, the fission foil reactors, explosively driven systems, fusion, and antimatter. The results of the studies by the panel will be provided. 13 refs., 6 figs., 2 tabs.

**34112** (SAND–91-1987C) **Instrumentation and control for space nuclear propulsion.** Thome, F.V.; King, D.B. Sandia National Labs., Albuquerque, NM (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109226–14: AIAA/NASA/OAI conference on advanced SEI technologies, Cleveland, OH (United States), 3-4 Sep 1991). Order Number DE91018351. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Space nuclear propulsion represents a major change for developers of Instrumentation and Control (I&C) systems. The reactor operates at much higher temperatures and at greater power densities than today's power reactors. Reliability requirements are much greater for high cost manned and unmanned missions. Today's reactor I&C engineers resort to out-of-core flux and temperature measurements because of the severe environments. This practice of indirectly monitoring reactor conditions has caused the industry problems from TMI-2 to Chernobyl. These problems may get worse for higher power densities, for higher temperature, and for fast reactors. I&C serves the purpose of plant integration. It must detect, measure, evaluate, and control the reactor and its cooling system, the power conversion system, and distribution system. The lack of emphasis on this aspect of reactor designs is a contributor to reliability problems and poor "reactor on" times for US power reactors. The major I&C issues for space nuclear propulsion and some of the solutions are presented. 2 refs., 3 figs., 3 tabs.

## 2209 Reactor Safety

*Refer also to citation(s) 33800, 34034, 34037, 34045, 34054, 34055, 34065, 34102, 34104, 34106, 34108, 34112, 34595, 34995, 35143, 35331*

**34113** (ANL/CP–73482) **Experiments for IFR fuel criticality in ZPPR-21.** Olsen, D.N.; Collins, P.J.; Carpenter, S.G. Argonne National Lab., Idaho Falls, ID (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910993–15: International conference on nuclear criticality (ICNC) safety, Oxford (United Kingdom), 9-13 Sep 1991). Order Number DE91018635. Source: OSTI; NTIS; INIS; GPO Dep.

A series of benchmark measurements was made in ZPPR-21 to validate criticality calculations for fuel operations in Argonne's Integral Fast Reactor. Six different mixtures of Pu/U/Zr fuel with a graphite reflector were built and criticality was determined by period measurements. The assemblies were isolated from room return problems by a lithium hydride shield. Analysis was done using a fully-detailed model with the VIM Monte Carlo code and ENDF/B-V.2 data. Sensitivity analysis was used to validate the measurements against other benchmark data. A simple RZ model was defined the used with the KENO code. Corrections to the RZ

model were provided by the VIM calculations with low statistical uncertainty. 7 refs., 5 figs., 5 tabs.

**34114** (ANL/CP–73995) **R&D activities at Argonne National Laboratory for the application of base seismic isolation in nuclear facilities.** Seidensticker, R.W. Argonne National Lab., IL (United States). [1991]. 16p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9108145–1: 11. post structural mechanics in reactor technology (SMIRT) conference, Nara (Japan), 26-28 Aug 1991). Order Number DE91017975. Source: OSTI; NTIS; INIS; GPO Dep.

Argonne National Laboratory (ANL) has been deeply involved in the development of seismic isolation for use in nuclear facilities for the past decade. Initial focus of these efforts has been on the use of seismic isolation for advanced liquid metal reactors (LMR). Subsequent efforts in seismic isolation at ANL included a lead role in an accelerated development program for possible use of seismic isolation for the DOE's New Production reactors (NPR). Under funding provided by the National Science Foundation (NSF) Argonne is currently working with Shimizu in a joint United States-Japanese program on response of seismically-isolated buildings to actual earthquakes. The results of recent work in the seismic isolation program elements are described in this paper. The current Status of these programs is presented along with an assessment of work still needed to bring the benefits of this emerging technology to full potential in nuclear reactors and other nuclear facilities. 38 refs., 3 figs.

**34115** (BNL-NUREG–46511-Rev.) **Prism reactor system design and analysis of postulated unscrammed events: Revision.** Van Tuyle, G.J.; Slovik, G.C. Brookhaven National Lab., Upton, NY (United States). Aug 1991. 7p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-911001–3-Rev.: International conference on fast reactor systems and fuel cycles, Kyoto (Japan), 27 Oct - 1 nov 1991). Order Number DE91018727. Source: OSTI; NTIS; INIS; GPO Dep.

Key safety characteristics of the PRISM reactor system include the passive reactor shutdown characteristic and the passive shutdown heat removal system, RVACS. While these characteristics are simple in principle, the physical processes are fairly complex, particularly for the passive reactor shutdown. It has been possible to adapt independent safety analysis codes originally developed for the Clinch River Breeder Reactor review, although some limitations remain. In this paper, the analyses of postulated unscrammed events are discussed, along with limitations in the predictive capabilities and plans to correct the limitations in the near future. 6 refs., 4 figs.

**34116** (BNL-NUREG–46542) **The alara center and its information service–ACE.** Khan, T.A.; Baum, J.W. Brookhaven National Lab., Upton, NY (United States). Aug 1991. 34p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9108157–1: Annual meeting of the boiling water reactors (BWR) owner's group, Seattle, WA (United States), 1-2 Aug 1991). Order Number DE91018730. Source: OSTI; NTIS; INIS; GPO Dep.

In compliance with its congressional mandate to oversee the radiation safety of workers at nuclear power plants, the NRC asked Brookhaven National Laboratory (BNL) to create a center to help monitor efforts that were likely to reduce occupational radiation exposure. The NRC project required the ALARA Center to evaluate dose-reduction research and the ALARA-related programs, and to note any areas where additional effort may be fruitful. The Center also was directed to inform the NRC on promising research and developments related to ALARA that were being carried out abroad, and to examine areas where international collaboration may be valuable. This document discusses the objectives of the ALARA Center.

**34117** (CIEMAT–672) **Influence of Chemistry on source term assessment.** Herranz, L.E.; Lopez Diez, I.; Rodriguez Maroto, J.J.; Martinez Lopez-Alcorocho, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1991. 44p. Order Number DE92700011. Source: OSTI; NTIS (US Sales Only).

The major goal of a phenomenology analysis of containment during a severe accident situation can be split into the following ones: to know the containment response to the different loads and to predict accurately the fission product and aerosol behavior. In this report, the main results coming from the study of a hypothetical accident scenario, based on LA-4 experiment of LACE project, are presented. In order to do it, several codes have been coupled: CONTEMPT4/MOD5 (thermalhydraulics), NAUA/MOD5 (aerosol physics) and IODE (iodine chemistry). It has been demonstrated the impossibility of assessing with confidence the Source Term if the chemical conduct of some radionuclides is not taken into account. In particular, the influence on the iodine retention efficiency of the sump of variables such as pH has been proven. (Author)

**34118** (CONF-910137–, pp. 33) **Implementation of recent ICRP guidance in Ontario Hydro's Radiation Safety Program.** Armitage, G. (Ontario Hydro, Pickering (Canada)); Whillans, D. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The practical application of recent ICRP guidance to Ontario Hydro's radiation safety program is described. Impacts in the areas of external dosimetry, internal dosimetry and emission limits for radionuclides from nuclear facilities are discussed. In the case of some radiological hazards encountered in Ontario Hydro's facilities, such as insoluble particulate carbon-14 and elemental tritium, no specific guidance from the ICRP exists and it was necessary to use general principles to develop specific controls and techniques. A brief discussion of benefits and difficulties during the implementation is included.

**34119** (CONF-910137–, pp. 34-37) **Nuclear power industry review of 10 CFR 20 implementation documents.** Schmitt, J.F.; Maisler, J.J. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The revision of 10 CFR 20, Standard for Protection Against Radiation will result in changes to radiation protection programs at commercial nuclear power facilities. The record of the nuclear power industry for radiation protection of public and worker health and safety is very good and continues to improve. Because of its commitment, the industry is concerned that implementation of the changes required by the new regulation be accomplished in a correct, effective and efficient manner which continues the improvements in radiation protection. Development and review of implementation documents (e.g., Regulatory Guides) associated with the revised Part 20 is an important part of this effort. This paper discusses activities performed and plans developed by NUMARC, the nuclear power industry's organization responsible for generic regulatory matters, regarding implementation documents associated with the revised 10 CFR 20.

**34120** (CONF-910137–, pp. 38) **Implementation of NCRP 91 recommendations on occupational exposure to ionizing radiation at a large nuclear facility.** Hall, R.M. Jr. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Short communication. IONIZING RADIATIONS/occupational exposure; NUCLEAR FACILITIES/radiation protection; RADIATION PROTECTION/recommendations; IMPLEMENTATION; RECOMMENDATIONS

**34121** (CONF-910137–, pp. 39-45) **Impacts on power reactor health physics programs.** Meyer, B.A. (Carolina Power and

Light Co., Raleigh, NC (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The impacts on power reactor health physics programs form implementing the revised 10 CFR Part 20 will be extensive and costly. Every policy, program, procedure and training lesson plan involving health physics will require changes and the subsequent retraining of personnel. At each power reactor facility, hundreds of procedures and thousands of people will be affected by these changes. Every area of a power reactor health physics program will be affected. These areas include; ALARA, Respiratory Protection, Exposure Control, Job Coverage, Dosimetry, Radwaste, Effluent Accountability, Emergency Planning and Radiation Worker Training. This paper presents how power reactor facilities will go about making these changes and gives possible examples of some of these changes and their impact on each area of power reactor health physics program.

**34122** (CONF-910137–, pp. 46-54) **Methodology for development of health physics procedures at research reactors in agreement states.** Woodard, R.C. (Univ. of Texas, Austin (USA)); Bauer, T.L.; Wehring, B.W. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The University of Texas at Austin is awaiting final license approval to operate a new 1 MW TRIGA reactor for teaching and research. All reactor and laboratory operations, experiments, and monitoring are carried out under health physics procedures that address to ensure consideration of all applicable documents as references in order to comply with the regulations and accepted good practices. This paper examines the development of one procedure Radioactive Material Control by use of the method. The process is examined as a tool to apply to any health physics procedure development. Further discussion focuses on the regulatory anomalies observed during development of the procedure and presents the arguments for the authors resolution of these issues. The design of the reactor facility is also detailed to allow for understanding of the problems encountered during procedural development.

**34123** (CONF-910137–, pp. 118) **Practical methods for exposure control/management at nuclear facilities.** Twiggs, J.A. (Duke Power Co., Charlotte, NC (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Exposure management/reduction is very important to Duke Power Company. Practical exposure control/reduction techniques applied to their reactor vessel head disassembly outage activity have consistently reduced personnel exposure for this task. The following exposure control methods have worked for use and will be the industry's direction for the 1990's. A summary of these methods includes: (a) move the responsibility of exposure management from the Radiation Protection group to the Maintenance group; (b) reduce area source term by removal of source; (c) improve working environments in radiation areas by minimizing protective clothing usage; and (d) maximize the use of electronic instruments to allow remote monitoring.

**34124** (CONF-910137–, pp. 139) **Exposure control during high maintenance jobs.** Hinson, C.S. (Nuclear Regulatory Commission, Washington, DC (USA)); Wigginton, J.E. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Occupational radiation doses at US light-water-cooled reactors (LWRs) have been decreasing every year since 1983. In 1989, the LWR average dose per reactor reached its lowest point since 1973. Historically, maintenance-related activities have accounted for between 70 and 75% of the total occupational doses at US LWRs, and most of this maintenance-related dose is accrued during plant outages. This paper will focus on high dose maintenance jobs such as steam generator replacement, recirculation pipe replacement/crack repair, induction heating stress improvement, and steam generator tube plugging/sleeving and will discuss how the doses associated with these jobs have declined over the past several years through the implementation of various ALARA techniques.

**34125** (CONF-910137–, pp. 140-152) **Recommendations, requirements, and radioactive particles.** Bell, J.M. (Nuclear Regulatory Commission, Washington, DC (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Hot particles consisting of activated metal debris and fuel fragments have received increased attention in the last five years. This increased attention resulted from the increased use of more sensitive whole body friskers at nuclear power plants, the relatively high local skin doses associated with the particles, and skin dose limits that were established before hot particles, and skin dose limits that were established before hot particles became a problem and before radiobiological effects data for the particles became available. The skin dose distribution and biological effects associated with hot particles differ from those associated with more uniform skin contamination and differences exist in the scientific community as to which effects should be protected against by a limit on exposures from particles. The NRC staff recognized the need for provisions in the Federal regulations specific to hot particle exposures and requested guidance from the National Council on Radiation Protection and Measurements (NCRP). NCRP Report No. 106 was provided to the NRC early in 1990. The International Commission on Radiological Protection (ICRP) is also developing recommendations for limits on exposures from hot particles. The NRC is supporting research on hot particle effects and will likely develop a rule for hot particle exposures.

**34126** (CONF-910137–, pp. 163) **Exposure management - INPO perspective.** Jacobs, R.H. (Institute of Nuclear Power Operations, Atlanta, GA (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The slide presentation provides an overview of INPO's mission and programs. The focus of the presentation is on the nuclear power industry occupational radiation exposure trends, current activities, and the future outlook for controlling radiation exposure. Discussion will include progress the industry has made over the last 10 years, unplanned radiation exposures and observations of the root cause of these incidents, precursors to high exposure incidents, and INPO's continuing role in radiation exposure management.

**34127** (CONF-910137–, pp. 165-181) **ALARA at nuclear power plants.** Baum, J.W. (Brookhaven National Lab., Upton, NY (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Implementation of the ALARA principle at nuclear power plants presents a continuing challenge for health physicists at utility corporate and plant levels, for plant designers, and for regulatory agencies. The relatively large collective doses at some plants are being addressed through a variety of dose reduction techniques. Initiatives by the ICRP, NCRP, NRC, INPO, EPRI, and BNL

ALARA Center have all contributed to a heightened interest and emphasis on dose reduction. The NCRP has formed Scientific Committee 46-9 which is developing a report on ALARA at Nuclear Power Plants. It is planned that this report will include material on historical aspects, management, valuation of dose reduction ($/person-Sv), quantitative and qualitative aspects of optimization, design, operational considerations, and training. The status of this work is summarized in this report.

34128 (CONF-910137–, pp. 153-162) **Skin dose from distributed radioactive sources and hot particles - Regulations and recommendations.** Porter, S.W. (Porter Consultants, Ardmore, PA (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The issues concerning Beta Dosimetry, Hot Particle Dosimetry, and associated dose to skin have been highlighted since the 1979 TMI-2 accident report of the Presidential Commission. The conclusions drawn from the DOE/EML International Beta Dosimetry Symposium of 1983 are still valid. The questions of location(s) of the radiosensitive layer of human skin, the most valid method of skin dose measurement and interpretation of associated radiobiological data are still lingering. The need for improving beta calculation standards and procedures are more evident now than in 1983. This paper will discuss the newest ICRP and NCRP recommendations, as well as the regulations and guidelines from the NRC. I would expect that the draft recommendations published in this paper will be considerably changed by the time of the January, 1991 presentation of this paper.

34129 (CONF-910137–, pp. 204-212) **Occupational risk and lifetime exposure.** Lapp, R.E. (LAPP, Inc., Alexandia, VA (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Any lowering of annual radiation limits for occupational exposure should be based on industry experience with lifetime doses and not on a worst case career exposure of 47 years. Two decades of experience show a lifetime accumulation of less than 1.5 rem for workers with measurable exposure. This is 5% of the normal lifetime exposure of Americans to natural and medical radiation. Any epidemiology of the US nuclear power workforce's two decade long exposure would have to focus on excess leukemia. Application of the Hiroshima and Nagasaki cancer mortality shows that too few leukemias would be expressed to permit a feasible epidemiology. Ionizing radiation appears to be a mild carcinogen as compared to physical and chemical agents presented in the occupational environment. A realistic factor in determining any change in occupational exposure limits for ionizing radiation should take into account the past performance of the licensee and potential health effects applicable to the workplace. Specifically, the lifetime exposure data for workers at nuclear power plants and naval shipyards should be considered. The nuclear industry and the US Navy have detailed data on the annual exposure of workers with a combined collective exposure approaching 1 million worker-rem. The lifetime dose for naval personnel and shipyard workers averages 1.1 rem J 1990. Shipyard workers have an annual dose of 0.28 rem per work-year and a mean exposure time of 4.4 years. The data apply to workers with measurable dose.

34130 (CONF-910137–, pp. 218-231) **Experiences in limiting radiation exposure to the embryo/fetus in nuclear power plants.** Kelly, J.J. (New York Power Authority, White Plains (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

This paper presents the results of a survey of operating nuclear reactors and nuclear fuel fabrication facilities in the US. The survey obtained information on the number of women radiation workers in those plants over the last ten years and the number of workers potentially exposed to radiation while pregnant. Information on plant exposure limits for pregnant workers practiced at these plants and whether these limits comply with NCRP guidance and proposed NRC regulatory limits will also be presented. The discussion will include the effects of unions, labor arbitration, and legal actions on these policies. The unique problems of fuel manufacturers in addressing the proposed NRC regulations for embryo/fetus exposure will also be presented.

34131 (CONF-9104135– II.A.1.7-II.A.1.9) **DOE technical staff training at the Savannah River Site.** Bryson, R.A. (Westinghouse Savannah River Co., Aiken, SC (USA)). Oak Ridge National Lab., TN (United States). Apr 1991. From 9. symposium on the training of nuclear facility personnel; Denver, CO (United States); 14-18 Apr 1991. In *Proceedings of the ninth symposium on the training of nuclear facility personel.* 623p. Order Number DE91010496. Source: Available from National Technical Information Service, US Department of Commerce, 5285 Port Royal Rd., Springfield VA 22161.

A formal, accredited training program for technical staff personnel at Department of Energy (DOE) nuclear facilities was mandated by the DOE in November, 1989 by the establishment of DOE Order 5480.18, Accreditation of Performance-Based Training for Category A Reactors and Nuclear Facilities. The accreditation of DOE nuclear training programs applies to programs at Category A reactors and non-reactor nuclear facilities that have been designated as high hazard or selected moderate hazard operations. At the Savannah River Site (SRS), which is located near Aiken, South Carolina, four reactor facilities and eleven non-reactor facilities were designated in the DOE Order to implement a performance-based training program that could be accredited by an independent accrediting board. These facilities consist of nuclear production, processing, and waste management operations that produce nuclear materials for the Department of Energy's Defense Programs mission. In 1991, over 26,000 personnel are employed at SRS. The technical staff training program at SRS is one of nine programs that DOE has specified for accreditation. These programs are modeled after the INPO training programs in the commercial nuclear power industry. This presentation will describe the efforts underway at SRS regarding the technical staff training program efforts.

34132 (CONF-9104135– IV.A.3.9-IV.A.3.10) **Susquehanna SES maintenance supervisor training and certification.** Deckman, M. Oak Ridge National Lab., TN (United States). Apr 1991. From 9. symposium on the training of nuclear facility personnel; Denver, CO (United States); 14-18 Apr 1991. In *Proceedings of the ninth symposium on the training of nuclear facility personel.* 623p. Order Number DE91010496. Source: Available from National Technical Information Service, US Department of Commerce, 5285 Port Royal Rd., Springfield, VA 22161.

Susquehanna's program targets all Supervisors, Supervisor Candidates, and Temporary Supervisors that are responsible for in-plant maintenance or maintenance support activities, including: mechanical maintenance; electrical maintenance; maintenance support (labor support, radwaste, etc.); mobile construction support (mechanical and electrical); chemistry; health physics; maintenance planning; and instrument and controls. The program integrates the three major areas of direct Supervisory responsibilities: (1) Leadership and Management - Skills that require interpersonal activities that are typically humanistic and subjective; such as coaching, motivating, communications, etc. (2) Technical and Administrative - Knowledge that is directly related to the job of Supervising from the production, regulatory, accountability perspective. These topics are very objective and include training on topics such as workpackages, plant chemistry parameters, radiological concerns, etc. (3) Technical Skills - Ensure each Supervisor is technically competent in the plant systems, components, or equipment he/she is tasked with maintaining or overseeing. Typical skills found in this area are, circuit breaker maintenance, primary system sampling, or overhauling pumps.

34133 (DUN–559) **Douglas United Nuclear, Inc. monthly report, February 1966.** Douglas United Nuclear, Inc., Richland, WA

(United States). 15 Mar 1966. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (HAN–94154-Del.). Order Number DE92000574. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report from Hanford discloses reactor operating procedures. One failed enriched fuel element and two failed production test fuel elements were removed from the reactors. The enriched failure was from a split core in the bumper element. The production test failures (two in one tube) were enriched uranium oxide fuel elements. A total of 390 tons of production fuels were produced, 100 percent of forecast. Facilities engineering at the k reactors is discussed, along with administrative procedures. (GHH)

**34134** (DUN–5000-Pt.1) **In-core gamma traverse of tube 3560 from tube 3561: 105-KW, July 13, 1968.** Erickson, G.L. Douglas United Nuclear, Inc., Richland, WA (United States). 15 Sep 1968. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000543. Source: OSTI; NTIS (US Sales Only); GPO Dep.

At 12:00 AM, 7/12/68, a request from the 3560 KW Incident Task Force was made to effect a gamma traverse of PT 3560 from PT 3561 for the purpose of locating an approximately 7-inch separation in PT 3560. As the information was urgently needed, the required probe and instrumentation was to be fabricated from immediately available materials, instrumentation, and technology. A gamma level traverse of process tube (PT) 3560, 105-KW, was made from adjacent process tube 3561 for the purpose of locating separations in PT 3560. Shown are the results of these traverses which located a separation at 27 ft. 6 inches from the front face nozzle of PT 3561 or 27 feet 8 inches from the front face nozzle edge of PT 3560. Also shown are the results of a second traverse on 7/18/68 which located another separation 40 feet from the front face nozzle edge of PT 3561. The collimator was fabricated from an available 0.8% uranium K4D bore fuel element. The gamma detector used was an Amperex 18529 operating in the current mode. A second collimating probe and circuitry was constructed which provided greater background shielding in addition to automatic background subtraction capability; however, it was not completed in time for use during this incident. 6 figs., 3 tabs.

**34135** (DUN–5000-Pt.2) **Tube No. 3560 KW removal equipment description.** Wegener, E.A. Douglas United Nuclear, Inc., Richland, WA (United States). 26 Aug 1968. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000573. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube #3560-KW flow stoppage incident which occurred in June 1968, occasioned the design of several unique items of tooling which were used in the removal of the problem tube. One pertinent fact must be remembered – all of the tool and equipment design work was accomplished under conditions of severe time limitation and changing circumstances and, while each item functioned as designed, some improvisation was necessary. With additional mock-up testing and further modifications, the various items of tooling could very likely be improved and their performance and reliability be enhanced. It is the purpose of this document to describe, in detail, the equipment used and briefly outline its on-reactor performance. The method of removing the process tube and charge as proposed and accepted involved the removal of the graphite immediately around the tube by means of a coring procedure. This then would free the tube in the channel and permit it to be easily pushed from the reactor. The proposed cored hole size was 3 inches in diameter. Therefore, in order to get a cutter of this diameter into the graphite, the cast iron thermal shield blocks, and, in the rear, the die block would also have to be bored to that dimension. In addition, the centering flange and shielding donuts had to be removed from the sleeve through the biological shield to allow access to the cast iron. Tooling to perform all of these functions with the tube in the channel was designed, fabricated, tested, and used on reactor. 7 figs.

**34136** (DUN–5000-Suppl.2) **Tube 3560-KW flow stoppage incident, 3560-KW tube removal plan: Supplement 2.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 23 Jun 1968. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000547. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube number 3560-KW flow stoppage incident which occurred at Hanford in June 1966, occasioned the design of several unique items of tooling and the corresponding operating procedures. This plan is to sketch out the over-all plan of attack to remove the tube and fuel from 3560-KW. Throughout these plans, adequate provisions will necessarily be made for eliminating or reducing the consequences of a uranium fire, which is the primary hazard.

**34137** (DUN–5000-Suppl.3) **Tube 3560-KW flow stoppage incident corrective action procedure No. 1, 3560-KW rear cap and perf removal: Supplement 3.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 23 Jun 1968. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000548. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube number 3560-KW flow stoppage incident which occurred at Hanford in June 1968, occasioned the design of several items of tooling and corresponding procedures for the removal of the problem tube. This brief report discusses corrective action procedure number 1 (3560-KW rear cap and perf removal). (GHH)

**34138** (DUN–5000-Suppl.4) **Tube 3560-KW flow stoppage incident corrective action procedure No. 2: Supplement 4.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 28 Jun 1968. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000549. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube number 3560-KW flow stoppage incident which occurred at Hanford in June 1966, occasioned the design of several unique items of tooling and the corresponding operating procedures. This brief report describes corrective action procedure number 2 (Rear Fuel Element Removal Procedure). (GHH)

**34139** (DUN–5000-Suppl.5) **Tube 3560-KW flow stoppage incident corrective action procedure No. 3: Supplement 5.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 27 Jun 1968. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000550. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube number 3560-KW flow stoppage incident which occurred at Hanford in June 1966, occasioned the design of several unique items of tooling and the corresponding operating procedures. This brief report describes corrective action procedure number 3 (Alternative Rear Fuel Element Removal Procedure).

**34140** (DUN–5000-Suppl.6) **Tube 3560 KW flow stoppage incident corrective action procedure No. 4: 200 psi hydraulic test of front section of tube 3560.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 28 Jun 1968. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000551. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 4 (200 PSI hydraulic test of front section of tube). (BN)

**34141** (DUN–5000-Suppl.7) **Tube 3560 KW flow stoppage incident corrective action procedure No. 10: Rear gunbarrel removal and dummy gunbarrel installation on channel 3560.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 28 Jun 1968. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000541. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 5 (Rear gunbarrel removal and dummy gunbarrel installation). (BN)

**34142** (DUN–5000-Suppl.8) **Tube 3560 KW flw stoppage incident corrective action procedure No. 6: Alternate No. 2 rear fuel element removal procedure.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 28 Jun 1968. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000553. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 6. (Alternate #2 rear fuel element removal procedure). (BN)

**34143** (DUN–5000-Suppl.9) **Tube 3560 KW flow stoppage incident corrective action procedure No. 7: Borescope examination of downstream fuel piece.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 26 Jun 1968. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000554. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 7 (Borescope examination of downstream fuel piece). (BN)

**34144** (DUN–5000-Suppl.10) **Tube 3560 KW flow stoppage incident corrective action procedure No. 8: Removal of front cap from tube 3560 KW.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 29 Jun 1968. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000555. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 8 (Removal of front cap from tube). (BN)

**34145** (DUN–5000-Suppl.11) **Tube 3560 KW flow stoppage incident corrective action procedure No. 10: 140 psi measured leak test on front section of tube 3560.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 29 Jun 1968. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000557. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 10 (140 PSI measured leak test on front section of tube). (BN)

**34146** (DUN–5000-Suppl.12) **Tube 3560 KW flow stoppage incident corrective action procedure No. 11: Through-tube water transmission test.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 3 Jul 1968. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000558. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage for flow stoppage incidents under corrective action procedure number 11 (Through-tube water transmission test). (BN)

**34147** (DUN–5000-Suppl.13) **Tube 3560 KW flow stoppage incident corrective action procedure No. 12: Borescope examination of upstream fuel piece.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 3 Jul 1968. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000559. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 12 (borescope examination of upstream fuel piece).

**34148** (DUN–5000-Suppl.14) **Tube 3560 KW flow stoppage incident corrective action procedure No. 14.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 3 Jul 1968. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000560. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 14 (200 PSI hydraulic test of Vanstone of tube 3560). (BN)

**34149** (DUN–5000-Suppl.15) **Tube 3560 KW flow stoppage incident corrective action procedure No. 15: Borescope examination of upstream fuel pieces through transfer mechanism.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 3 Jul 1968. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000561. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 15 (Borescope examination of upstream fuel pieces through transfer mechanism). (BN)

**34150** (DUN–5000-Suppl.16) **Tube 3560 KW flow stoppage incident corrective action procedure No. 9: Fuel removal from front.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 6 Jul 1968. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000562. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 9 (fuel removal from front). (BN)

**34151** (DUN–5000-Suppl.17-Add.1) **Tube 3560 KW flow stoppage incident corrective action procedure No. 13, Addendum 1: Supplementary tube removal procedure.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 11 Jul 1968. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000563. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube #3560-KW flow stoppage incident which occurred in June, 1968, occasioned the design of several unique items of tooling which were used in the removal of the problem tube. In the removal, prevention of reactions between uranium hydrides and air was an utmost concern. This brief report describes corrective action procedure number 13 (tube removal). The method of removing the process tube and charge as proposed and accepted involved the removal of the graphite immediately around the tube by means of a coring procedure. This then would free the tube in the channel and permit it to be easily pushed from the reactor. The proposed cored hole size was 3 inches in diameter. Therefore, in order to get a cutter of this diameter into the graphite, the cast iron thermal shield blocks, and, in the rear, the die block would also have to be bored to the dimension. In addition, the centering flange and shielding donuts had to be removed from the sleeve through the biological shield to allow access to the cast iron. Tooling to perform all of these function with the tube in the channel was designed, fabricated, tested, and used on reactor. 7 figs.

**34152** (DUN–5000-Suppl.18) **Tube 3560 KW flow stoppage incident corrective action procedure No. 17: Removing fuel elements from front using snout cask.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 11 Jul 1968. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000564. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube #3560-KW flow stoppage incident which occurred in June 1968, occasioned the design of several unique items of tooling which were used in the removal of the problem tube. Care was required to insure that radiation hazards were minimized. This brief report describes corrective action procedure number 17 (Removing fuel elements from front using snout case).

**34153** (DUN–5000-Suppl.19) **Tube 3560 KW flow stoppage incident corrective action procedure No. 16: Drilling and removing fuel elements from rear.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 11 Jul 1968. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000565. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube #3560-KW flow stoppage incident which occurred in June 1968, occasioned the design of several unique items of tooling which were used in the removal of the problem tube. Corrective actions required monitoring of radiation hazards. This brief report describes corrective action procedure number 16 (Drilling and removing fuel elements from rear) along with the safety efforts involved.

**34154** (DUN–5000-Suppl.20) **Tube 3560 KW flow stoppage incident corrective action procedure No. 18: Internal tube cutting.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 20 Jul 1968. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order

Number DE92000566. Source: OSTI: NTIS (US Sales Only): GPO Dep.

The tube #3560-KW flow stoppage incident which occurred in June 1968 occasioned the design of several unique items of tooling which were used in the removal of the problem tube. One pertinent fact must be remembered – all of the tool and equipment design work was accomplished under conditions of severe time limitation and changing circumstances and, while each item functioned as designed, some improvisation was necessary. With additional mock-up testing and further modifications, the various items of tooling could very likely be improved and their performance and reliability be enhanced. This brief report describes corrective action procedure number 18 (internal tube cutting).

34155 (DUN–5000-Suppl.21) **Tube 3560 KW flow stoppage incident corrective action procedure No. 19: Internal cutting of dummy gunbarrel, removal of centering flange and gas sleeve.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 20 Jul 1968. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000567. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube #3560-KW flow stoppage incident which occurred in June 1968, occasioned the design of several unique items of tooling which were used in the removal of the problem tube. This brief report describes corrective action procedure number 19. (Internal cutting of dummy gunbarrel, removal of centering flange and gas sleeve). (GHH)

34156 (DUN–5000-Suppl.22) **Tube 3560 KW flow stoppage incident corrective action procedure No. 20: Rear gunbarrel donut removal.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 20 Jul 1968. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000568. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube#3560-KW flow stoppage incident which occurred in June 1968, occasioned the design of several unique items of tooling which were used in the removal of the problem tube. Since previous procedures have involved both drilling and sawing within the tube, it must be assumed that uranium and zirconium materials have been converted to a finely divided, and therefore most pyrophoric, state. Consequently, an inert atmosphere should be maintained within the tube at all times. In addition, it must be assumed that personnel on the rear work platform will be exposed to a significant hazard from the consequences of a fire, and appropriate personnel protection practices must be employed. This brief report describes corrective action procedure number 20 (Rear gunbarrel donut removal). (GHH)

34157 (DUN–5000-Suppl.23) **Tube 3560 KW flow stoppage incident corrective action procedure No. 21: Thermal shield and die block cutting.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). Jul 1968. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000569. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 21 (Thermal shield and die block cutting). (BN)

34158 (DUN–5000-Suppl.24) **Tube 3560 KW flow stoppage incident corrective action procedure No. 22: Graphite boring over process tube: Phase 1.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 14 Jul 1968. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000570. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The tube #3560-KW flow stoppage incident which occurred in June 1968, occasioned the design of several unique items of tooling which were used in the removal of the problem tube. This brief report describes corrective action procedure number 22 (Graphite boring over process tube, phase 1).

34159 (DUN–5000-Suppl.25) **Tube 3560 KW flow stoppage incident corrective action procedure No. 23, Graphite boring over process tube: Revision 1: Supplement 25.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 22 Jul 1968. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000571. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 23 (Graphite boring over process tube – Revision 1). (BN)

34160 (DUN–5000-Suppl.26) **Tube 3560 KW flow stoppage incident corrective action procedure No. 24 - Tube removal through bored channel.** Maguire, A.R. Douglas United Nuclear, Inc., Richland, WA (United States). 23 Jul 1968. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000572. Source: OSTI; NTIS (US Sales Only): GPO Dep.

This document details the procedures to be followed for flow stoppage incidents under corrective action procedure number 24 (Tube removal through bored channel). (BN)

34161 (ES/CSET–9) **Unreviewed safety question determination application guide: Safety Analysis Report Update Program.** Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States). Sep 1991. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000419. Source: OSTI; NTIS; GPO Dep.

The basic purpose of the Unreviewed Safety Question Determination (USQD) process is to ascertain if a change to a facility can be made without a prior safety review and approval by the original approving body. The USQD process judges whether the change could result in the facility being outside its authorization basis. If the change could result in the facility being outside its authorization basis, the change involves an Unreviewed Safety Question (USQ). The authorization basis consists of those aspects of the facility design basis relied upon by the original approving body to authorize operation. The authorization basis would typically include the facility Safety Analysis Report, Technical Safety Requirements (TSRs), Operational Safety Requirements (OSRs), Technical Specifications, DOE-issued Safety Evaluation Reports, Safety Analysis Report Update Program documents, Safety Studies, Safety Assessments, Risk Assessments, Facility Safety Evaluations, and any applicable commitments made to comply with Department of Energy (DOE) orders or policies. Steps in the USQD process include defining the changes being evaluated; evaluating the process by which the change is accomplished; then the potential effects of the change are compared to the authorization basis for the facility to determine if the change could result in the facility being outside is authorization basis. The USQD will provide input to the change control board for facilities placed under configuration management to aid their understanding of the extent of a proposed change and whether or not the change should be authorized. The USQD will also provide input to the categorization of reportable occurrences under DOE Order 5000.3A, Occurrence Reporting and Processing of Operations Information. This report provides an overview of the steps in the USQD process and detailed instructions and examples intended primarily for use by the personnel who perform, review, and approve the USQDs. 3 refs., 3 figs.

34162 (EUR–12320-Vol.2) **Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.** Commission of the European Communities, Luxembourg (Luxembourg). 1990. 386p. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). Source: OSTI; NTIS (US Sales Only).

Since the first international workshop in 1985, the Chernobyl accident has led to greatly increased interest in the use of computers as an aid to modelling the actual situation in the event of an accident on the basis of the information then available in order to extrapolate in time and space, to obtain a better understanding of what actions might be appropriate and to investigate the potential influence of specific countermeasures. The proceedings provide an overview of the state of the art as it existed in early 1989, including

as they do, not only contributions from Western Europe but also from the USA, Japan and Eastern Europe.

34163 (EUR–12320-Vol.2, pp. 3-22) **Instituting the CEA rapid transmission network for environmental radioactivity measurement.** Robeau, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept. de Protection Sanitaire); Sauve, A.M.; Laporte, J.; Alphonse, L.; Lebrun, L.; Bensimon, C. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (In French). (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

The radiological impact of the Chernobyl accident has been followed at CEA sites using measuring stations installed for monitoring the local environments. This has shown a need for re-specification and improved coordination of the measurements in order to provide coherent radiological coverage of the CEA sites and by extension a potential contribution to national surveillance. The structure of the new measurement chain is based on the three stages of the evolution of an accident: real-time measurement of airborne activity, deferred spectrometric measurements of air, water and ground deposition activity and monitoring of significant links in the food chain. Radiological protection recommendations allow derivation of the levels of radioactivity which the equipment and methods must be able to detect. A rapid information transmission system allows the measurements to be collected together for the purposes of analysis and interpretation to the benefit of CEA central and site managements and of the public authorities.

34164 (EUR–12320-Vol.2, pp. 23-49) **Interfacing real-time radiological field data with predictive long range transport models.** Raes, F. (Commission of the European Communities, Ispra (IT). Joint Research Centre); Zarimpas, N.; Graziani, G. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

The extent in space and time of the Chernobyl accident and the uncertainty of its source term has raised several challenges to the modelers of atmospheric transport. An interesting working hypothesis that emerged is that models predicting contamination levels over time scales larger than one or two days, can only be successful if they are used in conjunction with the results from real-time radiological field measurements. The paper discusses how such data might be used together with long range transport models to optimize the predictions of where a radioactive cloud is expected to go. The ideas are illustrated using a simple trajectory model and radiological data generated after the Chernobyl accident.

34165 (EUR–12320-Vol.2, pp. 51-74) **Real-time regression schemes for integrating measurements with emergency response predictions.** Edwards, L.L. (Lawrence Livermore National Lab., CA (US)); Harvey, T.F.; Pitovranov, S.E. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

If real-time radiological measurements are available, current computer technology provides an opportunity for improving hazard predictions during an emergency. The potential for substantially reducing prediction uncertainties by integrating real-time observations and predictions into an automated emergency response system exists. In developing such a system, great care must be taken to properly balance prediction-model sophistication, data quality and timing, response time, and a data/model integration scheme. The Atmospheric Release Advisory Capability (ARAC) of the U.S. Department of Energy has initiated a program to establish the feasibility of incorporating an automated, real-time method of correcting predictions using radiological measurements acquired during an emergency. This Predictor/Corrector (P/C) Model is predicated on (1) being able to obtain real-time measurements, (2) having a sophisticated prediction model capable of running many times during an emergency response and, (3) using an appropriately designed non-linear regression scheme. Model sophistication will be designed as a function of available response time. The current plan is to use ARAC's MATHEW/ADPIC model as the P/C predictor, but with the model restructured with multiple loops to provide differing degrees of sophistication, to be invoked as response time allows. We study different regression schemes potentially appropriate for the Predictor/Corrector Model. We use the ARAC Instantaneous Point Source (IPS) model to predict observations that were made at the Savannah River Plant for $SF_6$ tracer releases during 1983. The number of IPS runs and the range of the initial parameter guesses that result in acceptable predictions are determined. Recommendations are made of the best candidates for implementation in the MATHEW/ADPIC model.

34166 (EUR–12320-Vol.2, pp. 75-100) **Reliability of real-time computing with radiation data feedback at accidental release.** Deme, S. (Hungarian Academy of Sciences Budapest (HU). Central Research Institute for Physics); Feher, I.; Lang, E. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

At the first workshop in 1985 we reported on the real-time dose computing method used at the Paks Nuclear Power Plant and on the telemetric system developed for the normalization of the computed data. At present, the computing method normalized for the telemetric data represents the primary information for deciding on any necessary counter measures in case of a nuclear reactor accident. In this connection we analyzed the reliability of the results obtained in this manner. The points of the analysis were: how the results are influenced by the choice of certain parameters that cannot be determined by direct methods and how the improperly chosen diffusion parameters would distort the determination of environmental radiation parameters normalized on the basis of the measurements ($^{131}$I activity concentration, gamma dose rate) at points lying at a given distance from the measuring stations. A further source of errors may be that, when determining the level of gamma radiation, the radionuclide doses in the cloud and on the ground surface are measured together by the environmental monitoring stations, whereas these doses appear separately in the computations. At the Paks NPP it is the time integral of the airborne activity concentration of vapour form $^{131}$I which is determined. This quantity includes neither the other physical and chemical forms of $^{131}$I nor the other isotopes of radioiodine. We gave numerical examples for the uncertainties due to the above factors. As a result, we arrived at the conclusions that there is a need to decide on accident-related measures based on the computing method that the dose uncertainties may reach one order of magnitude for points lying far from the monitoring stations. Different measures are discussed to make the uncertainties significantly lower.

34167 (EUR–12320-Vol.2, pp. 101-112) **Real-time emergency computations for nuclear installations.** De Witt, H. (Systemplanung Ingenieurbuero fuer Wissenschaftlich Technischen Umweltschutz, Aachen (DE)); Brenk, H.D.; Knaup, A.G.; Kruschel,

K.P. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

In case of accidental atmospheric releases of radioactive substances it is an urgent need for decision makers to be provided with data as actual and precise as possible. In the past the assessment of atmospheric pollutants based on measured meteorological parameters and hypothetical emission rates was associated with relatively great uncertainties. To improve this situation the new system OLDES has been developed. This is in the first step achieved by feedback of actual measurements of the environmental impact into diagnostic calculations in order to adapt the calculations to the current measurements. The result is a more realistic set of model parameters, including the source term. Subsequently these parameters are used as input data for the second step of OLDES which is real-time projection of the exposure situation. Generally OLDES consists of 3 different modes. Two of them depend on the amount and quality of measurements available at the time when the emergency occurs. The third is an accident simulator in order to train operators of OLDES and for emergency exercises. Mode no.1 is designed to supply consistent diagnostic interpretations of a variety of locally and chronologically different measurement data. Operation of mode 1 is started manually by exceeding certain thresholds of the dose rate or activity concentration. In the very early phase of an emergency when emissions are assumed but have not yet taken place, dose rate and activity measurements are not available. In such cases mode no. 2 can be operated, at least to evaluate early dose assessments for various possible release scenarios to answer the so-called what-if-questions. All modi are presented in detail.

**34168** (EUR–12320-Vol.2, pp. 113-145) **Feasibility of feed-back of environmental data to optimize utilization of assessment models in quasi-real-time.** Sohier, A. (Centre d'Etude de l'Energie Nucleaire, MOL (BE)); Govaerts, P. Commission of the European Communities, Luxembourg (Luxembourg). 1990. Contract no B16.0106.B. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

Early real-time modelling of consequences of an accidental nuclear release will be faced with gross uncertainties in the input parameters. A methodology, involving the optimization of input parameters based on environmental survey data, has to be worked out to quickly narrow the output uncertainty. Some points of importance in an environmental survey program will be discussed using an atmospheric tracer data base.

**34169** (EUR–12320-Vol.2, pp. 149-165) **Computer-based tools for radiological assessment of emergencies at nuclear facilities in the United Kingdom.** Bevington, L.M. (Health and Safety Executive, London (UK). Nuclear Installations Inspectorate); Robinson, I.F.; Davison, S.; Strachan, S.J. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

HMNII is responsible for regulating the activities at licensed nuclear sites in the UK. In the event of an emergency being declared at any of these sites. HMNII would mobilize an emergency response team. This team would, interalia, monitor the activities of the operator at the affected site, assess the actual or potential radiological consequences of the event and provide briefings to senior members of government. Central to this response to an emergency is the assessment effort that would be provided by the Bootle Headquarters Emergency Room. To facilitate the assessments carried out at Bottle, computer based tools have been developed. The major licensed nuclear facilities in the UK fall into two broad groups, civil power reactors and nuclear chemical plant. These two types of facilities pose different levels of radiological hazard as a result of their different radioactive inventories and the different physical processes in operation. Furthermore these two groups of facilities pose different problems in assessing the radiological hazard in emergency situations. This paper describes the differences in approach used in designing and using computer based tools to assess the radiological consequences of emergencies at power reactor and chemical plant sites.

**34170** (EUR–12320-Vol.2, pp. 167-182) **The need for an integrated monitoring database and assessment system.** Morrey, M. (National Radiological Protection Board, Harwell (UK)); White, I.F. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

As an aid to managing the offsite consequences of an accidental release of radionuclides, much emphasis has been placed on the provision of computer programs which can model the dispersion of radionuclides through the atmosphere and the terrestrial environment. At the very early stages of an accident, when the available monitoring information is sparse, reliance upon such predictive models is essential. However, our experience following Chernobyl shows that, as more detailed data become available, emphasis quickly shifts from theoretical predictions to assessments based on measurements. In order to facilitate this, it is helpful to have an integrated monitoring database and assessment computer program, which can both display measurements and provide comparisons of predictions with reality. Important requirements of such a system include the ability to: - display measurements on maps; - show trends with time; - alert the users to measurements which exceed selected values - combine measurements with predictive models, for comparison purposes and to provide dose estimates; - compare the predicted spread of the radioactive plume with the extent of measured contamination. It is also important that such a system can be used simultaneously by several individuals, each performing a variety of functions. It should be quick and flexible to use, acting as a tool-kit in the hands of an expert, and it should unambiguously record all assumptions and actions taken in producing maps and dose assessments. Currently NRPB is designing such an integrated system for its own use, the major features of which are described.

**34171** (EUR–12320-Vol.2, pp. 197-214) **Improving the user interface of real-time models of offsite consequences.** Jackson, R.G. (UKAEA Safety and Reliability Directorate Culcheth (UK)). Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

The UKAEA UMPIRE program is a micro-computer based dispersion model for the prediction of the off-site consequences of an accidental release of radioactive material to the atmosphere. It is

primarily intended as a calculational tool for the health physicist assessing possible doses to members of the public. It is essential that any computer program for use in emergencies is simple to use and presents information in an unambiguous way. Advances in micro-computers have removed many limitations on the size and speed of the computer code. This has enabled emphasis to be placed on making the program user friendly. The process involves close co-operation with the user to determine his needs and to explain the capabilities of the system. This paper describes the way in which the operation and presentation of results have been tailored to the demands on the health physicist. It also discusses the way in which qualitative assessment of trends in simple monitoring results can be used to make judgements about the nature of the release before more detailed information is available and about parameters which cannot be directly measured.

**34172** (EUR–12320-Vol.2, pp. 215-228) **The expert assistant in accident management.** Goddard, A.J.H. (Imperial College of Science and Technology London (UK). Dept. of Mechanical Engineering); Cannell, R.J. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

In the event of a nuclear accident in proximity to an urban area, the consequences resulting from the complex processes of environmental transport of radioactivity would require complex countermeasures. Emphasis has been placed on either modelling the potential effects of such an event on the population, or on attempting to predict the geographical evolution of the release. Less emphasis has been placed on the development of accident management aids with a in-built data acquisition capability. Given the problems of predicting the evolution of an accidental release of activity, more emphasis should be placed on the development of small regional systems specifically engineered to acquire and display environmental data in the most efficaceous form possible. A wealth of information can be obtained from appropriately-sited outstations which can aid those responsible for countermeasures in their decision making processes. The substantial volume of data which would arrive within the duration and during the aftermath of an accident requires skilled interpretation under conditions of considerable stress. It is necessary that a management aid notonly presents these data in a rapidly assimilable form, but is capable of making intelligent decisions of its own, on such matters as information display priority and the polling frequency of outstations. The requirement is for an expert assistant. The XERSES accident management aid has been designed with the foregoing features in mind. Intended for covering regions up to approximately 100 kms square, it links with between 1 and 64 outstations supplying a variety of environmental data. Under quiescent conditions the system will operate unattended, raising alarms remotely only when detecting abnormal conditions. Under emergency conditions, the system automatically adjusts such operating parameters as data acquisition rate.

**34173** (EUR–12320-Vol.2, pp. 249-260) **Table top exercises a teaching and research tool.** Lakey, J.R.A. (Institution of Nuclear engineers London (UK)). Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

Table Top Exercises have been used in training Command and Control Teams at the Royal Naval College Greenwich for over 10 years since they allow a wide range of scenarios to be reviewed. The exercise commences with the scene setting information and the teams reaction to the information proceeds like a seminar. This technique is surprisingly effective but it lacks feed back and is not necessarily performed in real-time so a formal exercise based on a real accident was designed. The staff solution to the event was derived from the NRC Advisory Documents. The exercise was limited to the Early Phase of a real accident which had occurred in the USA but it was suitably disguised and based on data presented in an information booklet which the trainees were expected to read and digest before the exercise commenced. This exercise has been tested at the University of Surrey, in Sweden and at Harvard University and to date over 200 people have participated. On each application the exercise was modified and it became apparent that real-time environmental data was needed and this was met by the IRDAM code. The code was used initially to extrapolate limited measurements to outer areas of the Emergency Planning Zone. Substantial difficulties emerged for the teams who were not usually qualified nuclear engineers: confusion in the use of radiation units, numeracy of the candidates, inadequate input data, inability to interpret the output and errors made due to stress and communication difficulties. DNST has made some improvements to the interfacing of the codes and these will be reported.

**34174** (EUR–12320-Vol.2, pp. 265) **Asterix a code for use in public information systems.** Stolk, D.J. (Nijverheidsorganisatie TNO, The Hague (NL)); Van Renswoude, G.J.; Warmerdam, P. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

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**34175** (EUR–12320-Vol.2, pp. 266-267) **Ringhals NPP - system 553.** Mattsson, C.G. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

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**34176** (EUR–12320-Vol.2, pp. 270-273) **OIVA an off-site dose prediction system using real-time plume trajectories.** Lahtinen, J. (Finnish Centre for Radiation and Nuclear Safety Helsinki (FI)); Blomqvist, L. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

A system called OIVA for off-site dose calculations has been developed at the Finnish Centre for Radiation and Nuclear Safety (STUK) to be used by the advisory expert group in case of an emergency at a Finnish nuclear power plant. The system presents dose or dose-rate predictions superposed on maps on graphics terminals or as colour hardcopies. Since OIVA is a multi-user system

it can be utilized either by the advisory expert group in Helsinki or by the liaison persons at the local command centre. So far terminals have been placed at the command centres only during preparedness exercises and would have to be transported there in an accident situation. Permanent installations at the command centres are planned in about two years, pending a decision on the upgrading of the OIVA system hardware. The present hardware of OIVA is based a HP 1000 minicomputer system with HP2397A and HP2627A colour graphics terminals and a HP PaintJet colour graphics printer. A more detailed description of the system has been reported earlier. Here only a short updated overview is given.

**34177** (EUR–12320-Vol.2, pp. 274) **REM a decision support system for nuclear emergencies.** Stolk, D.J. (Nijverheidsorganisatie TNO, The Hague (NL)): Van Renswoude, G.J.; Kloks, A.J.J. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

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**34178** (EUR–12320-Vol.2, pp. 277-286) **Resy a german real-time subsystem.** Pasler-Sauer, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

In the Federal Republic of Germany an interactive DECISION AIDING SYSTEM named DAISY is currently under development. It will consist of the subsystems RESY (Rechnergestutztes Entscheidungshilfe-SYstem/REal-time SYstem) and RADE-AID (Radiological Accident DEcision Alding Syst.) covering all phases of imaginable accidental releases of radionuclides into the atmosphere. RESY is up to now an exclusively German development, RADE-AID is a Dutch-English-German project partially funded by the CEC. Design purposes of DAISY are . to evaluate continuously the prevailing off-site emergency conditions in the near and far field and to display coherent information about them . to provide a best estimate of future conditions . to quantify the risks and benefits of feasible alternatives of countermeasures . to give advice to decision makers about the optimum nature, ranking, extent and timing of countermeasures, and . to be a tool for training of decision makers and emergency personnel.

**34179** (EUR–12320-Vol.2, pp. 287-301) **Rade-aid a decision support system to evaluate countermeasures after a radiological accident.** Wagenaar, G.; Van Den Bosch, C.J.H.; Weger, D. de. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

After Chernobyl the authorities in many countries were overwhelmed by the enormous amount of information that was being generated by measuring and monitoring programs. In making decisions, this information had to be combined with the results of specific countermeasures, in order to determine the optimal strategy with respect to a large number of consequences. The development of RADE-AID, the Radiological Accident Decision AIDing system, is aimed at providing a powerful tool in the decision-making process. RADE-AID is developed by TNO (The Netherlands) in a joint contract with KfK (FRG) and NRPB (UK). In the first phase a demonstration system will be built, called RADE-AID/D. RADE-AID/D will be used as a decision support system in the intermediate and late phase after a radiological accident. RADE-AID/D will consider countermeasures with respect to external exposure and internal exposure by food ingestion. Countermeasures are evaluated considering reduction in doses and in numbers of health effects, costs, and social effects. The paper covers the structure of the program, presentation of data and results, and the decision analysis technique that is being used. This decision analysis part is an important feature of the system; an advanced decision analysis technique is used, that is able to compare data of varying nature. Furthermore the place of RADE-AID in the decision-making process will be treated. RADE-AID/D is an interactive computer program, that offers the user the possibility to enter relevant data and to have data and results displayed in a variety of ways. Furthermore the system contains an advanced decision analysis technique, that is able to compare data of varying nature. Input data for the decision analysis calculations are provided by models from UFOMOD and MARC-codes.

**34180** (EUR–12320-Vol.2, pp. 303-318) **Provisions for calculating radiological consequences at the IPSN Centre Technique de Crise.** Crabol, B. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept. d'Analyse de Surete); Manesse, D.; Robeau, D. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (In French). (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

The IPSN has organized for emergency situations a Centre Technique de Crise (CTC) whose purpose is to supply the public authorities with a technical analysis of events and all the information on their foreseeable evolution especially in terms of radioactive discharges to the environment and the radiological consequences. The CTC is itself organized into four groups responsible for overall management, receipt of information from the accident site, diagnosis and prognosis of the site situation and evaluation of the radiological consequences respectively. The group in charge of radiological consequences relies for meteorological support on facilities provided by the Meteorologie Nationale, more particularly as regards forecasts and the data necessary for calculating atmospheric transport, firstly local to the site and subsequently on regional and transfrontier scales. For dose calculation the group has a number of possibilities - graphs, a plume model and a puff model (SIROCCO), the latter being able to deal with all kinetic aspects of the discharge and all meteorological sequences. The choices have been made giving priority to proven tools which are easy to use, especially with a view to the first hours of the emergency when information will be sparse and there will be little time to respond. Emphasis has, therefore, been placed on user friendliness of the programmes and on the presentation of the results. Such presentation is backed up by images from data banks, comprising site plans, demographic distributions around the sites, various maps etc... All of these facilities operate on the CTC's own computer network. Finally documentation, deliberately limited to information regarded as essential to the group's work in order to facilitate its recovery, has been assembled.

**34181** (EUR–12320-Vol.2, pp. 319-340) **An emergency preparedness system the french project ecran.** Biscay, P. (Electricite de France (EDF), 78 - Chatou (FR)); Michelin, J.M.;

Moussafir, J. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI: NTIS (US Sales Only).

Electricite de France (E.D.F) has developed the prototype of a new emergency preparedness system. The prototype system, called E.C.R.A.N. (Estimation des Consequences Radiologiques d'un Accident Nucleaire), includes: (1) - A local computerized system which collects meteorological data, stack exit data, and radiological data on the plant site, and receives the meteorological forecast data. All the data are gathered in a database with includes topography and digitized maps of the area. This dedicated workstation provides real-time computation of actual or forecast consequences up to 10 Km within 10 minutes. (2) - A central system, based on E.D.F. large scientific mainframe computers, where the heavier meteorological computations required for regional scale assessment (several hundreds of km) are carried out. At this level, we use the HERMES mesoscale model, nested on larger scale forecasts. This central system is connected by specialized lines to the French Meteorological Office's computing center, which delivers twice a day an operational 48 hours large scale forecast (grid size about 35 km). (3) - A communication network (E.D.F. computer network) which allows fast and reliable access to data and results for every group involved in the decision process. A prototype for the local system, which is a UNIX workstation, has been operating on the Cruas power plant (Rhone Valley in the South-East of France) since September 1987. A portable software package called ADSO was developed to integrate the numerical models in real time, and to build site-independent, machine-independent and sensor-independent databases. This paper describes the general structure of this system, the models it uses, its present state of development, the possible improvements and its future use in EDF operational emergency organization.

**34182** (EUR–12320-Vol.2, pp. 341-356) **Park and Euralert a german and an european computer code for the assessment of radiation doses and the management of radioactive contaminations of large areas.** Mueller, H. (Gesellschaft fuer Strahlen und Umweltforschung m.b.H. Muenchen Neuherberg (DE)); Jacob, P.; Paretzke, H.G.; Proehl, G.; Eklund, J.; Gregor, J.; Stapel, R. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8905115–: 2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation, Luxembourg (Luxembourg), 16-19 May 1989). In *Proceedings of the 2. International Workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation. Volume 2: Decision aids to offsite emergency management.* 386p. Order Number DE92703750. Source: OSTI; NTIS (US Sales Only).

In the Federal Republic of Germany, an Integrated Measuring and Information System (IMIS) is under development, which is designed to allow the fast detection and systematic measurement of relevant radioecological parameters in the case of radioactive contaminations of large areas. The data, measured as well as predicted by atmospheric dispersion models, will be processed every two hours by a Program system for the Assessment of Radiological Consequences (PARK), which is essentially based on the GSF radioecological model ECOSYS. A similar program system - EURALERT - is developed for the application in the member states of the European Communities. In this case the input data are essentially the local activity concentrations in air and in rain water which can be either measured data or predicted from appropriate atmospheric dispersion models. The atmospheric dispersion models for the short, medium and long-range transport used in EURALERT will not be discussed in this paper. The main tasks of the two codes are (a) the fast predictive assessment of the radiological situation with high spatial and temporal resolution and (b) to provide the quantitative data base for decisions on the optimum countermeasures in the case of large scale contaminations. Different living habits, climatic conditions and agricultural practices in different regions can be taken easily into account. A comparison of the prognosis with measured specific activities and an easy fine adjustment of parameters like the actual phase of vegetation, actual deposition velocities, interception or transfer parameters are possible. Counter-measures are characterized by amounts and local distributions of fodder, foodstuffs or people affected by it and by the respective predicted reduction of individual and collective radiation doses.

**34183** (EUR–12603) **Review studies on the state of the art of separate effects and component behaviour of LWR cooling systems.** Haefner, W. (Battelle-Institut e.V., Frankfurt am Main (DE). Abt Energietechnik): Fischer, K.; Bestion, D.; Lemonnier, H.; Mewes, D.; Beckmann, H. Commission of the European Communities, Luxembourg (Luxembourg). Sep 1990. 400p. Contract No. 3002-86-07 ELISPD;3006-86-07 ELISPF;3007-86-07 ELIS Source: OSTI; NTIS (US Sales Only).

In the frame of the Shared Cost Action (SCA) Reactor Safety 1985-87 programme Review Studies on the state of the art of separate effects and component behaviour (preparation for a possible future experimental programme) have been performed. The final reports of three of the selected topics closely related and of particular interest for the development of specific two-phase models are collected in this volume: - Contact condensation effects relevant to ECC-water injection into a cold leg main coolant pipe (Contract 3002-86-07 ELISPD, Battelle Frankfurt) - State of the art of two phase steam water flow in piping junctions (Contract 3006-86-07 ELISPF, CEA-CEN Grenoble) - Critical investigation and model development for countercurrent flow of gas and liquid in horizontal and vertical channels (Contract 3007-86-07 ELISPD, Universitat Hannover). Specific conclusions are drawn and recommendations are given in each of the three papers. A common conclusion is that for developing more general models applicable to a wider range of situations further experimental work needs to be done but with emphasis on larger pipe diameters of test sections up to 30 mm and increasing the system pressures. For better understanding the physical phenomena local parameters and their variations need to be measured more accurately by applying better and more advanced instrumentation.

**34184** (EUR–12990, pp. 19-24) **UK arrangements for environmental monitoring in the event of a civil nuclear accident.** Fry, F.A. (National Radiological Protection Board, Chilton (UK)). Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling.* 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

The UK, like most European countries, has reviewed its emergency response arrangements in the light of the experience of the Chernobyl reactor accident and some improvements have been initiated. In particular, the National Response Plan for accidents occurring overseas is well in-hand and a fully-operating system should be available early in 1992. This system can, and should, provide a national communication facility and a central, comprehensive data base that can be used in the event of any accident, no matter where it occurs - in the UK or overseas. In our view, the outstanding issue now is the development of the computer tools that aid the handling, display and interpretation of large amounts of data. Perhaps this is a topic that should be addressed at next year's REM Workshop.

**34185** (EUR–12990, pp. 25-36) **Denmark's on - line early warning radiation monitoring network.** Walmod-Larsen, O. (Riso National Lab., Roskilde (DK). Health Physics Dept.); Lippert, J. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real*

*Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling.* 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

In Denmark an emergency response coordination committee was set up to cope with the problems after the Chernobyl accident with participation of all relevant authorities. For help in an emergency situation the ARGOS (Accident Reporting and Guiding Operational System). system will be put into use. The ARGOS emergency evaluation computer system, which has been developed in cooperation with the Danish Environmental Protection Agency. is in operation in connection with the emergency planning for the east region of Denmark with regard to the Swedish nuclear power plant operating at Barseback. Inputs of measurement data are on-line available on data screens for evaluation in the emergency coordination centers, presented on suitable geographical maps, showing iso-contours calculated from the input. In case of an alert situation other systems can be put in operation, f.ex. mobile measuring units from the CDEPA's local, operational emergency centers. Their readings can then be put into the computing system parallel to the on-line stations and be presented by the ARGOS-system for evaluation in the emergency command centers. If another national authority in an alert situation requests a transfer of measurement data, and if this is agreed upon by the competent Danish authority, then the transfer can be arranged from the ARGOS-system, through agreed transmission channels. At present the ARGOS system is being improved and expanded by RNL to cover the whole Danish region and to present measurements from the on-line warning system.

**34186** (EUR–12990, pp. 37-52) **Contribution to the optimization of a network for monitoring and surveillance of environmental radioactivity in Spain.** Ortega, X. (Universitat Politecnica de Catalunya, Barcelona (ES). Inst. de Tecniques Energetiques). Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling.* 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

The work presented involves initial action consisting of sounding out the situation of environmental radiological surveillance systems in the countries of the E.E.C. and the corresponding emergency systems with their different features: institutional, technical and managerial. As regards the analysis of the functioning of a regional centralized network, this has been undertaken using the centralized Catalan network around the two nuclear sites, taking in 8 dose rate measuring stations. The latter study enabled us to get to know the variations in exposure rates in the different localities together with the natural causes that led to them. A calculation model was designed to determine the contribution to the environmental dose from the different radioactive components in the soil and this has been validated with data from the field. Finally, as regards Spain's REVIRA programme, are presented the main outlines drawn up by the Spanish Council for Nuclear Safety. In this respect, the experience gained through this study would prove particularly useful.

**34187** (EUR–12990, pp. 53-68) **Environmental monitoring and the application of predictive models for nuclear emergencies in the Netherlands.** Van Lith, D. (National Inst. of Public Health and Environmental Protection, BILTHOVEN (NL)); Smetsers, R.C.G.M.; Slaper, H. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling.* 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

In this paper the organization within the Netherlands of the technical information in case of a nuclear emergency is shortly described. Part of this structure is the fully automatic radioactivity measurement network and the Information and Documentation Centre. Considerations on the interface between real-time monitoring and predictive modelling are given and some practical applications are presented.

**34188** (EUR–12990, pp. 101-110) **Aerial measurements of radioactivity and meteorological parameters in real time.** Georgi, B. (Niedersaechsisches Inst. fuer Radiooekologie, Hannover (DE)); Schufmann, P.; Hoff, A.M.; Frenzel, E. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling.* 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

The aircrafts operating in the case of nuclear accidents have to be equipped with all necessary instruments for radioactivity, aerosol and gas sampling, chemical characterization and additional avionic for exact flight path recordings. In close cooperation with NIR, AERODATA, FAG and FhG-IFU will provide the research aircraft Beechcraft King Air 200 and/or Hawker Siddeley 125. Impactors and denuders are to be installed on the aircraft for particle and gaseous measurements. The aircraft should be made available in stand-by operation.

**34189** (EUR–12990, pp. 111-126) **The management of post-accident radiological data.** Hagan, J.P. (UKAEA Safety and Reliability Directorate, Culcheth, (UK)). Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling.* 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

This paper describes a computerized system to assemble and process post-accident radiological monitoring data in a form suitable for an interactive interface with a real-time atmospheric dispersion model. This system and the dispersion model are currently under development by SRD and the UK Meteorological Office as part of the UK National Response Plan for nuclear accidents.

**34190** (EUR–12990, pp. 127-150) **Method to be used to work back to the source term and for optimum control of parameters used in atmospheric transfer calculations.** Robeau, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses 92 (FR)); Oishi, S. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling.* 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

Many basic nuclear installations (power reactors, nuclear fuel reprocessing plants) are likely, in the case of an accident or an incident, to release radioactive gases and aerosols into the atmosphere. Past experiments have shown that it is difficult to determine the source term quickly. The source term means: - the chemical nature of the radionuclides released. - the amount of radioactivity released for each radionuclide. - the physical state of the various radionuclides released: gaseous, aerosol, organic or inorganic vapor. Accidental situations can in fact be summed up in two phases: the phase preceding discharge, and the phase including and following discharge. During the second post-accidental phase, a maximum of data must be obtained on the actual conditions of the discharge, such as its height, prevailing weather conditions, the composition of the discharge and its activity level, along with data on the deposit process (deposit rate, washing rate). These data are then used to estimate concentrations of radionuclides in the air, and of deposits on the ground, via atmospheric transfer models of varying degrees of complexity. The purpose of this study is to put forward a method using the results of air and ground level radioactivity measurements made in a given zone, to obtain an estimate of a source term, in order to calculate an air and ground level concentration field and to keep optimum control on parameters required for modelling.

**34191** (EUR–12990, pp. 151-164) **Interfacing real-time monitoring data with a long range transport and dispersion model.** Tassone, C. (Commission of the European Communities, Ispra,

(IT). Joint Research Centre); Grippa, G.; Raes, F.; Graziani, G. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155--: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling*. 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

Atmospheric transport models become less accurate when the forecasting period increases. However, as time elapses, real-time monitoring data can become available through international arrangements for early exchange of information (European Communities, IAEA). Full use should be made of these data to update the model predictions. In this paper we continue the work previously performed on the use of models in conjunction with monitoring data to predict the evolution of the radioactive cloud created in a nuclear accident. In the previous study we used a trajectory model and the Chernobyl data base of airborne Cs-137 to show that the forecast of trajectories improves substantially, if they are interfaced with monitoring data as they become available. The limitation of the study was mainly due to the fact that the trajectory model did not allow the evaluation of concentration values and therefore no quantitative comparison with the monitoring data could be performed. The trajectories used were calculated using the UK Met. Office fine mesh windfields. In the present study we have used a comprehensive transport and diffusion model which has been developed at Ispra. In view of a future connection between JRC Ispra and ECMWF the analyzed wind field data from the latter source were used. The quantification of the improvements in the forecasted field concentration has been calculated making use of some of the statistical parameters used in atmospheric transport model performance studies.

**34192** (EUR--12990, pp. 165-180) **The fractal nature of the european network for airborne radioactivity monitoring and its implications for the detectability of radioactive clouds.** Raes, F. (Commission of the European Communities, Ispra (IT). Joint Research Centre); Graziani, G. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155--: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling*. 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

Both the European Communities (EC) and the International Atomic Energy Agency (IAEA) have agreed upon a rapid exchange of radiological data among their member states, in case of nuclear emergencies. This will happen through an information network operated by the Commission of the European Communities (CEC) and/or through the Global Telecommunications System of WMO. Data coming from nation wide on-line monitoring networks will be among the very first to be exchanged. They will constitute an important source of information for the real-time assessment of the situation after large accidents with national and international impact. In particular when data on airborne radioactivity are availably early after an accidental release, they might be used to update long range transport model predictions for the period to follow. It is therefore important to analyze the national networks in an international context, to see what information they can offer and what limitations exist.

**34193** (EUR--12990, pp. 181-190) **Present status and future development of the European Community rapid information system.** Fraser, G. (Commission of the European Communities, Luxembourg (LU)). Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155--: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling*. 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

Following the Chernobyl reactor accident it was rapidly appreciated that, in addition to upgrading national radiological monitoring systems, action was required to facilitate international communication of the results obtained. The first such system was established by the Vienna Convention, drawn up under the auspices of the IAEA, which came into force in September, 1986. Subsequently the EC Council of Ministers decided in December, 1987, to set up a Community system which in many ways parallels that established by the Convention but differs significantly in certain aspects concerning its legal basis, initiation criteria, data provisions and communications requirements. The present paper describes the present status of the Community system and foreseeable future developments. It is a matter of policy that, to avoid unnecessary complications, this system should be, to the maximum extent practicable, fully compatible with that established by the Convention. Where appropriate, therefore, reference is also made to the latter system.

**34194** (HW--34847-Pt.2) **KW reactor incident—Investigation record: Testimony transcript [of] D. S. Lewis interview, January 25, 1955.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Feb 1955. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000542. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a transcript of the interview with D. S. Lewis with regard to the KW Reactor incident. (FI)

**34195** (HW--34847-Pt.3) **KW reactor incident—Investigation record: Testimony transcript [of] R. R. Meyers interview, January 24, 1955.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Feb 1955. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000538. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides a transcript of the interview with R. R. Meyers in regard to the KW Reactor incident. (FI)

**34196** (HW--34847-Pt.4) **KW reactor incident—Investigation record: Testimony transcript [of] R. A. Nederhood interview, January 24-25, 1955.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 11 Feb 1955. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000539. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This document provides the transcript of the R. A. Nederhood interview with regard to the KW Reactor incident. (FI)

**34197** (HW--74094-Vol.1) **Safety analysis and hazards evaluation: Six oldest Hanford production reactors: Hazards summary report, Volume 1.** General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 21 Jun 1963. 165p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (HAN--85705). Order Number DE92000494. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This series of Hazards Summary Reports is organized in three volumes, and as a compilation they represent the status of reactor safety and an assessment of reactor hazards to the six oldest Hanford production reactors. This document, Volume 1, "Safety Analysis and Hazards Evaluation – Six Oldest Hanford Production Reactors," presents a discussion of the principal hazards associated with these reactors including a safety analysis of nuclear, mechanical, and other accidents and a summary of reactor hazards.

**34198** (HW--74095-Suppl.1) **Slightly enriched uranium-thoria loading Hanford K production reactors: Hazards summary report, Supplement 1.** Nilson, R.; Carlson, P.A.; Owsley, G.F. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 15 Sep 1964. 128p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018773. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Atomic Energy Commission (AEC) has directed that 110 kg of clean U-233 be produced in the IPD production reactors. This material is to be used for physics experiments in support of the AEC's seed-and-blanket program. To produce this quantity of U-233 on the schedule requested, requires the utilization of a significant portion of the production capability of the five IPD reactors not slated for shutdown. Present plans call for utilizing the fringes

of all five reactors and the core of one K Reactor to produce the 110 kg of U-233. To cover all possible combinations of future E-Q loadings, this report treats the general case in which nearly the entire fuel loading of the reactor has been converted to coproduce U-233 and Pu-239. Fringe and core loading differences are identified whenever possible. Specifically, this report deals with the Hanford K Reactors; a companion report deals with the six smaller reactors. 13 refs., 12 figs., 4 tabs.

**34199** (HW–76431-RD) **Preliminary report of front nozzle failure tube 1162 KE.** Lessor, L.C. General Electric Co., Richland, WA (United States). Hanford Atomic Products Operation. 14 Jan 1963. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000576. Source: OSTI; NTIS (US Sales Only); GPO Dep.

At 2059 hours on January 12, 1963, KE reactor was scrammed by a low trip on Panellit gauge 1162. The low trip resulted after the front nozzle was completely severed at the downstream lug ring groove. Following is a summary of events that occurred. The previous operating history and operating conditions at time of nozzle failure are first presented.

**34200** (IWGFPT–37, pp. 117-124) **Application of X-radioscopy techniques to loca simulation tests on irradiated PWR fuel.** Manley, A.J. (AEA Technology, Windscale (UK)); Hindmarch, P.; Garlick, A. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

During a hypothetical major break loss of coolant accident (LOCA) in a PWR the cladding might distend under the action of the internal pressure in the fuel rods and could reduce the cross-sectional area for emergency coolant flow. In the presence of azimuthal temperature gradients the cladding will fail at lower diametral strains releasing the internal pressure and preventing further ballooning. These azimuthal temperature gradients are dependent primarily upon the eccentricity of the pellet stack within the ballooning cladding and this is therefore an important factor determining the degree of channel blockage that could result from a major break LOCA. This paper describes the three phases of an experimental programme in which lengths of irradiated PWR fuel rod were subjected to simulated LOCA tests in order to determine the eccentricity and mechanical stability of the fuel stack. In the first phase of the programme the cladding was ballooned and, after cooling, a resin was introduced through a spark-machined hole in the cladding to fix the fuel stack in position. The experimental approach was then further developed to allow real-time X-radiographic (X-radioscopic) viewing of the fuel stack during ballooning of the cladding. In the second phase the stack was viewed from one direction and finally, in the third phase, from two orthogonal directions. In some of the tests vibrations and end-loading were applied during ballooning so as to simulate the conditions in-reactor during reflood quenching. The two principal conclusions are that the mean fuel stack eccentricity is generally > 0.3 and that axial collapse of the fuel did not occur until the cladding diametral strain exceeded 50%. (author). 11 figs.

**34201** (JAERI-M–91-093) **Effects of radial core power profile on core thermo-hydraulic behavior during reflood phase in SCTF Core-I forced feed tests.** Iwamura, Takamichi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Sudo, Yukio; Sobajima, Makoto; Ohnuki, Akira; Abe, Yutaka; Murao, Yoshio; Osakabe, Masahiro; Adachi, Hiromichi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 97p. Order Number DE92713914. Source: OSTI; NTIS (US Sales Only); INIS.

An investigation of the effects of the radial core power profile on the thermo-hydraulic behavior during the reflood phase of the large break LOCA of a PWR has been conducted with the Slab Core Test Facility (SCTF). Since the power in an actual PWR is lower in the peripheral bundles than in the central bundles, the so called chimney effect due to radial core power profile is expected to improve the cooling of the higher power bundles. The SCTF simulates a full radius slab section of a PWR and therefore the effects of radial core power profile can be investigated. The revealed results obtained from four forced-feed reflood tests (S1-01, S1-06, S1-08 and S1-11) in the SCTF Core-I are; (1) Two-dimensional flow in the core was induced by the radial power distribution. The direction of cross flow was from the central high power region to the peripheral low power region above the quench front and the direction was reversed below the quench front. (2) The heat transfer coefficient at the highest power bundle of the steep power profile test was higher than that of the flat power profile test under the same total core power condition. (author).

**34202** (KFK–4854) **Estimates of limits to fuel/coolant mixing.** Park, G.C. (Wisconsin Univ., Madison, WI (USA). Dept. of Nuclear Engineering and Engineering Physics); Corradini, M.L. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. Jun 1991. 41p. Order Number DE92714344. Source: OSTI; NTIS (US Sales Only); INIS.

The vapor explosion process can involve the mixing of fuel with coolant prior to the explosion. A number of analysts have suggested limits to the amount of fuel/coolant mixing that could occur within the reactor vessel following a core melt accident. Past models are reviewed and a simplified approach is suggested to estimate a limit on the amount of fuel/coolant mixing possible. The approach uses concepts first advanced by Fauske in a different way. The results indicate that fuel temperature, ambient pressure and in particular the mixing length scale $D_{mix}$ are important parameters. For large values of $D_{mix}$ the fuel mass mixed in-vessel is limited to the range of 1-12 metric tons (1-10% of the core mass). (orig.).

**34203** (NUREG/CR–4219-Vol.7-No.2) **Heavy-section steel technology program: Semiannual progress report for April 1990–September 1990, Volume 7, No. 2.** Pennell, W.E. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Oak Ridge National Lab., TN (United States). Sep 1991. 115p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/TM–9593-Vol.7-No.2). Source: OSTI; NTIS; INIS; GPO.

The Heavy-Section Steel Technology (HSST) Program is conducted for the Nuclear Regulatory Commission (NRC) by Oak Ridge National Laboratory (ORNL). The program focus is on the development and validation of technology for the assessment of fracture-prevention margins in commercial nuclear reactor pressure vessels. Reorganization of the original HSST Program into separate programs with emphasis on fracture-mechanics technology (HSST) and materials-irradiation effects (HSSI) was previously completed. The revised HSST Program is organized in 10 tasks: (1) program management, (2) fracture methodology and analysis, (3) material characterization and properties, (4) special technical assistance, (5) crack-arrest technology, (6) cleavage-crack initiation, (7) cladding evaluations, (8) pressurized-thermal-shock technology, (9) analysis methods validation, and (10) fracture evaluation tests. The program tasks have been structured to place emphasis on the resolution fracture issues with near-term licensing significance. Resources to execute the research tasks are drawn from ORNL with subcontract support from universities and other research laboratories. Close contact is maintained with related research programs both in the United States and abroad. This report provides an overview of principal developments in each of the ten program tasks from April 1, 1990, to September 30, 1990. 70 refs., 63 figs., 17 tabs.

**34204** (NUREG/CR–4674-Vol.13) **Precursors to potential severe core damage accidents: 1990: Volume 13, Mian report and Appendix A: A status report.** Minarick, J.W. (Science Applications International Corp., Oak Ridge, TN (United States)); Dolan, B.W.; Cletcher, J.W.; Copinger, D.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Programs; Oak Ridge National Lab., TN (United States). Aug 1991. 170p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/NOAC–232-Vol.13). Source: OSTI; NTIS; INIS; GPO.

Twenty-eight operational events with conditional probabilities of core damage of $1.0 \times 10^{-6}$ or higher occurring at commercial light-water reactors during 1990 are considered to be precursors to potential severe core damage. These are described along with associated significance estimates, categorization, and subsequent analyses. This study is a continuation of earlier work, which evaluated the 1969–1981 and 1984–1989 events. The report discusses (1) the general rationale for this study, (2) the selection and documentation of events as precursors, (3) the estimation and use of conditional probabilities of subsequent severe core damage to rank precursor events, and (4) the plant models used in the analysis process. 16 refs., 1 fig., 17 tabs.

34205 (NUREG/CR–4674-Vol.14) **Precursors to potential severe core damage accidents, 1990: A status report: Volume 14, Appendices B and C.** Minarick, J.W. (Science Applications International Corp., Oak Ridge. TN (United States)); Dolan, B.W.; Cletcher, J.W.; Copinger, D.A. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Safety Programs; Oak Ridge National Lab., TN (United States). Aug 1991. 486p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. (ORNL/NOAC–232-Vol.14). Source: OSTI; NTIS; INIS; GPO.

Twenty-eight operational events with conditional probabilities of core damage of $1.0 \times 10^{-6}$ or higher occurring at commercial light-water reactors during 1990 are considered to be precursors to potential severe core damage. These are described along with associated significance estimates, categorization, and subsequent analyses. This study is a continuation of earlier work, which evaluated the 1969–1981 and 1984–1989 events. The report discusses (1) the general rationale for this study, (2) the selection and documentation of events as precursors, (3) the estimation and use of conditional probabilities of subsequent severe core damage to rank precursor events, and (4) the plant models used in the analysis process. This document provides appendices B and C of the report titled precursors and containment related and other event documentation respectively.

34206 (NUREG/CR–5606) **A review of the South Texas Project probabilistic safety analysis for accident frequency estimates and containment binning.** Wheeler, T.A. (Sandia National Labs., Albuquerque, NM (United States)); Lambright, J.A.; Sype, T.T.; Darby, J.L.; Walsh, B. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (United States). Aug 1991. 331p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC04-76DP00789. (SAND–90-1970). Source: OSTI; NTIS; INIS; GPO.

The objective of this review is to evaluate the South Texas Project (STP) Probabilistic Safety Analysis (PSA) for the USNRC. The PSA was reviewed for thoroughness of analysis, accuracy in plant modeling, legitimacy of assumptions, and overall quality of the work. The review is limited to the internal event analysis and the fire sequence analysis. This review is not a quantitative evaluation of the adequacy of the PSA. The adequacy of the PSA depends on the intended uses and must be addressed on a case-by-case basis by the licensee and the NRC. This review identifies strengths, weakness, and areas where additional clarification would assist the NRC in evaluating the PSA for specific regulatory purposes. The licensee, Houston Lighting and Power (HL&P), reviewed a draft version of this report prior to its final release to the USNRC. The responses provided by HL&P are provided in detail in appendices to this report, and they are summarized in the main body of the report. All issues raised during the review were adequately addressed by HL&P in the responses. 27 refs., 4 tabs.

34207 (NUREG/CR–5660) **Static and simulated seismic testing of the TRG-7 through -16 shear wall structures.** Farrar, C.R. (Los Alamos National Lab., NM (United States)); Baker, W.E.; Dove, R.C. Nuclear Regulatory Commission, Washington, DC (United States). Div. of Engineering; Los Alamos National Lab., NM (United States). Sep 1991. 99p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract W-7405-ENG-36. (LA–11992-MS). Source: OSTI; NTIS; INIS; GPO.

Results from the static, simulated seismic base excitation, and experimental modal analysis tests performed on the TRG-7 through -16 structures are reported. These results were used to establish the scalability of static and dynamic response measured on small structural models to the dynamic response of conventional concrete structures. In addition, these tests provided information concerning cumulative damage effects that occur in concrete structures when they are subjected to different dynamic load sequences. In contrast to previous results obtained in the early part of this program, TRG-7 through -16 responded to simulated seismic excitations with theoretical stiffness values until peak nominal base shear stress levels of 150 psi were reached. A summary of all experimental data obtained during this program is provided. 23 refs., 47 figs., 22 tabs.

34208 (ORNL/tr–91/3) **Design of research reactors to take into account a reactivity accident.** Abou Yehia, H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Protection et de Surete Nucleaire); Berry, J.L.; Sinda, T. Oak Ridge National Lab., TN (United States). 1991. 11p. Translated from report IAEA-SM-310/107, 434-446. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91018519. Source: OSTI; NTIS; INIS; GPO Dep.

A description is given of the procedures followed and the research performed in France with regard to designing pool type research reactors to handle an explosive accident of the BORAX type. The examples of the high flux reactor and ORPHEE, the last reactor built, are developed at length. Development of the procedures and studies on the basis of results obtained elsewhere is shown and the conservative assumptions used when taking into account such an accident are described. 2 tabs.

34209 (PNL–7825) **Review of physics methodology of ATR safety analysis.** Little, W.W.; Heaberlin, S.W. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000436. Source: OSTI; NTIS; INIS; GPO Dep.

At the request of EG&G Idaho, the Pacific Northwest Laboratory (PNL) performed a brief review of the physics methods employed in the safety analyses for the Advanced Test Reactor. PNL determined that the general approach used by EG&G was sound. Comparisons were made between the EG&G results and a simplified PBL model. These demonstrated good agreement. However, the lack of spacial treatment of the moderator density reactivity coefficient and exclusion of the test loops from the reactivity model were identified as potential problems. In addition to these two concerns, a series of more minor observations were offered to assist EG&G in their analyses. 2 refs., 2 figs.

34210 (SAND–90-2535) **Further development of the KIVA-DCH code for the analysis of the transport and chemical reaction of molten debris in direct containment heating experiments.** Sweet, D.W.; Washington, K.E.; Pilch, M. Sandia National Labs., Albuquerque, NM (United States). Sep 1991. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE92000090. Source: OSTI; NTIS; INIS; GPO Dep.

The chemistry and geometry models in KIVA-DCH have been enhanced to allow the code to be used for the analysis of steam-driven melt direct containment heating (DCH) experiments in the Surtsey facility at Sandia National Laboratories. The chemistry routine now includes, in addition to iron, models for the oxidation of zirconium, aluminum and chromium by steam as well as oxygen. The new geometry model allows for debris ejection at floor level rather than from a chute protruding into Surtsey. Other improvements made to the code include the provision of a more rigorous treatment for debris-atmosphere energy exchange, and a comprehensive method for specifying the injection of debris and blowdown gas. 9 refs., 5 tabs.

34211 (WHC-SA–1074) **Utilizing the Fast Flux Test Facility for international passive safety testing.** Shen, P.K.; Padilla, A.; Lucoff, D.M.; Waltar, A.E. Westinghouse Hanford Co., Richland, WA (United States). Jul 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-911001–9: International conference on fast reactor systems and fuel cycles, Kyoto (Japan), 27 Oct - 1 nov 1991). Order Number DE91017736. Source: OSTI; NTIS; INIS; GPO Dep.

A two-phased approach has been undertaken in the Fast Flux Test Facility (FFTF) to conduct passive safety testing. Phase 1 (1986 to 1987) was structured to obtain an initial understanding of the reactivity feedback components. The planned Phase 2 (1992 to 1993) international program will extend the testing to include static and dynamic feedback measurements, transient and demonstration tests, and gas expansion module (GEM) reactivity tests. The primary objective is to meet the needs for safety analysis code validation, with particular emphasis on reducing the uncertainties associated with structure reactivity feedback. Program scope and predicted FFTF responses are discussed and illustrated. 3 refs., 6 figs.

# 24 POWER TRANSMISSION AND DISTRIBUTION

*Refer also to citation(s) 34258*

## 2401 Power Systems

**34212** (EGG-WTD–9671) **ISV electrical power availability.** West, G.S. Sr. EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1991. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018787. Source: OSTI; NTIS; INIS; GPO Dep.

This document presents the engineering design file report for the In Situ Vitrification (ISV) Electrical Power Availability study. The purpose of this study is to assess whether electrical power at the Idaho National Engineering Laboratory is sufficient enough to supply any or all of the ISV field test programs. The capacities of the 15 kV-class distribution systems and the 138 kV substation transformers upstream were assessed to determine viable electrical service alternatives for the ISV test beds. Load-flow analyses were performed to determine actual distribution circuit capacities with respect to established voltage constraints. Load flow analysis validated that the area feeders for the Semi-Scale Test Facility, Loss-of-Fluid Test Facility, and Water Reactor Research Test Facility would support the proposed ISV test beds. Construction cost estimates for planning are provided for these three locations, which this study identified as the best locations for possible connection of the ISV electrical service. This report will be used to determine an appropriate location for the ISV field test equipment used for cold testing. 2 refs., 1 tab.

**34213** (LBL–30065) **Risk allocation in independent power contracts.** Kahn, E. Lawrence Berkeley Lab., CA (United States). Apr 1991. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000669. Source: OSTI; NTIS; GPO Dep.

This paper reviews evidence on the allocation of risks in long term contracts between private power producers and utilities. The primary source of data for this analysis is a sample of actual contracts. The sample includes 20 contracts for 4570 MW from eight states and 13 utilities. There are nine IPPs and 11 QFs. Half the contracts resulted from some kind of competitive bidding process. The sample is skewed toward large projects and emphasizes contracts recently signed. Such projects are apt to indicate future directions better than a more strictly representative sample. Private power contracts typically involve a generic allocation of risks between developers and utility ratepayers. Developers sign fixed payment contracts for capacity or investment related costs. To earn these payments, the projects are subject to performance standards. Developers also agree to a first-year variable cost which is the product of fuel cost and a fixed conversion efficiency, or "heat rate." The heat rate remains fixed, but future fuel costs are adjusted by an external index. Fuel cost indexation effectively transfers most fuel price risk to the utility ratepayer. Demand risk is also born, almost universally, by the utility and its ratepayers. Important variations on this generic risk allocation and the most significant additional contract clauses are summarized topically below. Price trends are also reviewed. 28 refs., 6 tabs.

**34214** (PNL-SA–19771) **An integrated energy approach to providing power and propulsion for the Space Exploration Initiative.** Coomes, E.P.; Dagle, J.E.; Bamberger, J.A.; Noffsinger, K.E. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9109226–17; AIAA/NASA/OAI conference on advanced SEI technologies, Cleveland, OH (United States), 3-4 Sep 1991). Order Number DE92000143. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A fully integrated energy-based approach to mission planning is needed if the Space Exploration Initiative (SEI) is to succeed. Such an approach would reduce the number of new systems and technologies requiring development. The resultant horizontal commonality of systems and hardware would reduce the direct economic impact of SEI and provide an economic benefit by greatly enhancing our international technical competitiveness through technology spin-offs and through the resulting early return on investment. Integrated planning and close interagency cooperation must occur if the SEI is to achieve its goal of expanding the human presence into the solar system and be an affordable endeavor. An energy-based mission planning approach gives each mission planner the needed power, yet preserves the individuality of mission requirements and objectives while reducing the concessions mission planners must make. This approach may even expand the mission options available and enhance mission activities. This paper describes power beaming as an energy-based approach to meeting the requirements for space power, space propulsion, surface power, and surface transportation. It examines the development of systems to meet requirements of near-Earth operations and how these systems and technologies can be used to meet SEI mission requirements. 5 refs.

## 2402 Power System Networks, Transmission and Distribution

*Refer also to citation(s) 34214*

**34215** (ETDE-IT–91-52) **HVDC system design.** Manzoni, G. Ente Nazionale per l'Energia Elettrica, Rome (Italy). 1990. 37p. (In Italian). Order Number DE92705848. Source: OSTI; NTIS (US Sales Only).

In general, high voltage direct current (HVDC) systems are used to transmit energy between two alternating current (HVAC) systems and require, in addition to a transmission line, two ac/dc conversion stations. In describing the basic design criteria, component typology/sizing, and operating principals of a HVAC system, this paper puts emphasis on a technical description of the Graetz, six pulse, natural commutation conversion bridge. This bridge is usually fed by the three phase system in ac, and is defined by three 120 degree phased electromotive forces with one reactance per phase. Included in the characterization of this key element is an explanation of how the resulting voltage is regulated. The paper provides specifications on conversion equipment installation criteria: connections; VAR systems; series thyristors; ac and dc filters; transformers; surge arresters; feedthrough insulators; smoothing reactors; overhead, and underwater transmission cables. An assessment is made of the advantages and disadvantages of HVDC transmission, as well as, the impact of transmission distance on system economics. The key design features of major installations located in different countries are then cited.

## 2403 Power Transmission Lines and Cables

*Refer also to citation(s) 34215*

**34216** (ALS/TR–91-005) **Transfer impedance of coaxial cables.** Ochem, H. (Siemens and Halske AG, Berlin (Germany)). Sandia National Labs., Albuquerque, NM (United States). 6 May 1991. 41p. Translated from Hochfrequenztechnik und Elektroakustik (Germany); 48: 182-191(1936). Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91018411. Source: OSTI; NTIS; GPO Dep.

This paper concerns the transfer impedance as a crucial parameter for the effect of external radio-frequency fields on coaxial cables. Calculation and measurement of transfer impedances for

closed tubes. shields resolved into strips, two-layer shields are involved (for the example of wideband cable). Mutual transfer impedance as a measure of crosstalk between adjacent coaxial cables is also discussed. 9 refs., 12 figs.

**34217** (DOE/S–0085P) **National Energy Strategy: Technical Annex 3, Electricity transmission access.** USDOE Office of the Secretary. Washington, DC (United States). [1991]. 51p. Sponsored by USDOE. Washington, DC (United States). Order Number DE91018505. Source: OSTI; NTIS; GPO Dep.

Increased access to electricity transmission lines for sellers and buyers of wholesale power could encourage competition in the industry, lower electricity costs, and enhance environmental quality. Achievement of the economic benefits potentially available through increased competition in generation of electricity could be constrained by the absence of adequate access to transmission. Calls for more open transmission have increased. Price differentials among utilities have caused wholesale buyers that cannot satisfy all of their own generating needs to seek alternative suppliers of electric power. Complex questions of economics, equity, and reliability are embedded in the concept of transmission access and in the issues surrounding access – such as pricing, dispute resolution, joint ownership of lines, and planning for future additions to transmission capacity. Utilities' obligations under state laws and regulation add layers of complexity. The purpose of this analysis is to explore these issues and suggest appropriate federal options. Three options for federal action on transmission are considered. The first is to allow the present pattern of case-by-case determination of transmission access policy to continue. The second is to examine existing laws for authorities that could be used expand wholesale transmission access while making the terms and conditions governing that access more predictable and orderly. Both these options would ideally involve rulemaking on transmission access, pricing, contracting, and capacity-expansion planning to define more clearly "just and reasonable" utility policies that are consistent with systemwide efficiency and reliability and with utilities' obligations under state law and regulation. The third option is to enact new federal legislation which could create an obligation for utilities to provide transmission service for wholesale customers. 1 fig.

**34218** (ETDE-IT–91-53) **Overhead power line lightninig protection (lightning model).** Dellera, L.; Garbagnati, E. Centro Elettrotecnico Sperimentale Italiano (CESI), Milan (Italy); Ente Nazionale per l'Energia Elettrica, Milan (Italy). 1990. 29p. (In Italian). Order Number DE92705849. Source: OSTI; NTIS (US Sales Only).

This paper presents a mathematical model, developed by ENEL (the Italian National Electricity Board) in collaboration with the CESI (Italy) labs, to simulate lightning bolt behaviour. The initial assumption is that there exists a substantial similarity between natural phenomena governing the triggering and progression in space of lightning and those giving rise to 30 meter long disruptive discharges obtained during the course of lab tests involving 300-1000 micro-second peak time impulses. The paper demonstrates how the model is able to analytically simulate the propagation of a bolt descending towards a target structure; impact; the formation of counter discharges deriving from the target's critical structural element; the propagation of the counter discharge up to eventual interception with the descending bolt.

### 2407 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 34217*

**34219** (DOE/BP–1681) **Sustaining the Northwest way of life: Discussion papers.** USDOE Bonneville Power Administration, Portland, OR (United States). Aug 1991. 56p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000887. Source: OSTI; NTIS; GPO Dep.

These Discussion Papers are from a number of organizations with a high stake in the future performance of the Bonneville Power Administration. Bonneville solicited papers from other organizations to assure a broaded-based discussion of the topics for the 1991 Programs in Perspective. PIP meetings will be held throughout the Northwest in September. PIP runs on a two-year cycle. The first year is aimed at discussion of broad, strategic issues. The second year evaluates specific program levels for all Bonneville programs and test them for affordability against financial constraints. This year's PIP focuses on strategic-issues discussion. It specifically asks for regional discussion to help put some flesh on the skeleton of Bonneville's own vision for its future: "Best for the Northwest Through Teamwork B... P... A... The Most Competitive and Socially Responsible Power System in the Nation" Specific topics are (1) achieving social responsibility and (2) conserving Northwest competitiveness. Bonneville executives chose this vision as a means of directing the organization into and beyond the 1990s. It guides the 3000 plus employees of the agency in their day-to-day operations. By asking for discussion of the terms "Most Competitive" and "Socially Responsible" in the 1991 PIP, Bonneville intends to better understand the diverse needs of its customers and constituents, and to become of even greater service to the Northwest. The papers are designed to help stimulate thought about the dimensions of the future direction of BPA. Bonneville intends that the real substance of PIP will occur in the meetings themselves. We hope that these papers will provoke new thinking, and that the interchange of views in the meetings will produce new approaches to the issues.

## 25 ENERGY STORAGE

### 2501 Magnetic

**34220** (ANL-Trans–90-13) **Evaluation of the toroidal-type superconducting magnetic energy storage system (SMES).** Terai, Seiichiro (Kansai Electric Power Co. Ltd. (Japan)); Kishida, Takuya; Minaguchi, Taiji; Murakami, Yoshishige; Toyota, Katsuyoshi; Doki, Naohiro; Fukada, Masaichi. Argonne National Lab., IL (United States). 22 Jun 1990. 6p. Translated from 1990 National IEE Convention in Japan, March 28–30, 1990. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9003288–1: 1990 national IEE convention, No City Given (Japan), 28-30 Mar 1990). Order Number DE91017797. Source: OSTI; NTIS; GPO Dep.

This study reports evaluations of the basic system of a toroidal-type superconducting magnetic energy storage system which has several MJ of magnetically stored energy. (JL).

### 2506 Thermal

**34221** (ORNL/TM–11582) **Calmac Ice Storage Test report.** Stovall, T.K. Oak Ridge National Lab., TN (United States). Aug 1991. 54p. Sponsored by Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC05-84OR21400. Order Number DE92000416. Source: OSTI; NTIS; GPO Dep.

The Ice Storage Test Facility (ISTF) is designed to test commercial ice storage systems. Calmac provided a storage tank equipped with coils designed for use with a secondary fluid system. The Calmac ice storage system was tested over a wide range of operating conditions. Measured system performance during charging was similar to that reported by the manufacturer. Both the measured average and minimum brine temperatures were in close agreement with Calmac's literature values, and the ability to fully charge the tank was relatively unaffected by charging rate and brine flow rate. During discharge cycles, the storage tank outlet temperature was strongly affected by the discharge rate. The discharge capacity was dependent upon both the selected discharge rate and maximum allowable tank outlet temperature. Based on these tests, storage tank selection must depend most strongly on the discharge conditions required to serve the load. This report describes Calmac system performance fully under both charging and discharging conditions. Companion reports describe ISTF test procedures and ice-making efficiency test results that are common to many of the units tested. 11 refs., 31 figs., 9 tabs.

### 2509 Batteries

**34222** (ALS/TR–91-007) **Nonaqueous secondary batteries.** Yamahira, Takayuki (Sony Corp. (Japan)); Anzai, Masanori. Sandia National Labs., Albuquerque, NM (United States). 24 Apr 1991.

16p. Translation of Japanese Patent Application Hei 1[1989]-294372, filed May 23, 1988, published November 28, 1989. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91017788. Source: OSTI; NTIS; GPO Dep.

The object of the present invention is to make possible the repeated use for a long period of time of nonaqueous secondary battery that contains in the battery case a negative electrode of a carbonized organic substance, a positive electrode with $L_xMO_2$ (where M is at least one of Co and Ni; x being $0.05 \leq x \leq 1.10$) and an electrolytic solution. The method comprises at least one charging operation of the battery before the sealing of their cells to inhibit the gas generation that would occur in the finished battery in its charging and discharging.

**34223** (ANL/CP–73233) **Dynamic-performance measurements of battery cells for electric vehicle and other applications.** Redey, L. Argonne National Lab., IL (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-911047–7: 180. meeting of the Electrochemical Society, Phoenix, AZ (United States), 13-18 Oct 1991). Order Number DE91018644. Source: OSTI; NTIS; GPO Dep.

Described is a method that has been used to (1) measure dynamic performance of research cells and (2) project performance (Wh/kg and W/kg) for full-size batteries of various designs when discharged in dynamic load profiles, such as the Simplified Federal Urban Driving Schedule (SFUDS). Discharged energy ($mWh/cm^2$) and power ($W/cm^2$) of research cells are measured under one-dimensional current distribution by powerdynamic or galvanodynamic discharge techniques. Static discharge and dynamic discharge produce significant differences in cell performance. Hence, the dynamic-performance measuring methods should be extremely useful, even at the early stage of battery R&D, when systems intended for dynamic application are being evaluated. 6 refs., 5 figs.

**34224** (LBL–31078) **Polymeric electrolytes for ambient temperature lithium batteries: Final report.** Farrington, G.C. (Pennsylvania Univ., Philadelphia, PA (United States). Dept. of Materials Science and Engineering). Lawrence Berkeley Lab., CA (United States); Pennsylvania Univ., Philadelphia, PA (United States). Dept. of Materials Science and Engineering. Jul 1991. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000711. Source: OSTI; NTIS; GPO Dep.

A new type of highly conductive $Li^+$ polymer electrolyte, referred to as the Innovision polymer electrolyte, is completely amorphous at room temperature and has an ionic conductivity in the range of $10^{-3}$ S/cm. This report discusses the electrochemical characteristics (lithium oxidation and reduction), conductivity, and physical properties of Innovision electrolytes containing various dissolved salts. These electrolytes are particularly interesting since they appear to have some of the highest room-temperature lithium ion conductivities yet observed among polymer electrolytes. 13 refs. 11 figs., 2 tabs.

**34225** (SAND–91-0130) **Characteristics and development report for the MC3246A thermal battery.** Scharrer, G.L.; Lasky, F.P.R.; Moya, L.M. Sandia National Labs., Albuquerque, NM (United States). Sep 1991. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE92000609. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the design intent, design considerations, system use, development, product characteristics, and early production history of the MC3246A Thermal Battery. This battery has a required operating life of 50 ms above 18.0 V across a 0.68 ohm load. The MC3246A employs the Li(Si)/LiBr-LiCl-LiF/$FeS_2$ electrochemical system. The battery is a hermetically sealed right circular cylinder, 51 mm long and 38 mm in diameter. The mass of the battery is 176 grams. The battery was designed and developed to replace the MC3246 (used on the B83 and B61-7 Preflight Controllers) and to provide the power needed by the Preflight Controllers for the B61-6,8 and the B90. This is the first DOE thermal battery to use the all-lithium electrolyte. 1 ref., 10 figs., 12 tabs.

## 2510 Economic, Industrial, and Business Aspects

*Refer also to citation(s) 34241*

# 29 ENERGY PLANNING AND POLICY

*Refer also to citation(s) 34229*

**34226** (ETDE-mf–2714418) **BDI - theses for a general energy policy concept.** Bundesverband der Deutschen Industrie e.V., Koeln (Germany). Feb 1991 5p. (In German). Order Number DE92714418. Source: OSTI; NTIS (US Sales Only).

The attitude of the Association towards important elements of German energy policy is documented in 18 theses in this paper. (UA).

## 2901 Energy Analysis and Modeling

*Refer also to citation(s) 34328, 34351, 35557*

## 2902 Economics and Sociology

*Refer also to citation(s) 34028, 34219, 34234, 34240, 34340, 34361, 35031, 35475, 35494*

**34227** (ENEA-RTI-STUDI-STRAT–90-08) **Elements for fiscal energy policy.** Sartori, P.; D'Angelo, E. ENEA, Rome (Italy). 1990. 67p. (In Italian). (RTI/STUDI-STRAT–90-8). Order Number DE92705866. Source: OSTI; NTIS (US Sales Only).

The energy surcharge policies of various developed countries are compared for different types of fossil fuels, and for electric power. This analysis is followed by a critical evaluation of the positions taken by renown fiscal policy strategists and of the impacts of fiscal policies on overall economic and energy policies. With regard to the planned European Common Market, the question of fiscal policy harmonization is examined in detail, and a look is given at the probable impacts upon Italy's energy system. An analysis of the role of Italian institutions leads to the assertion that there exists a strict correlation between the nation's fiscal system and energy policy, and that economic problems appear to override those which are purely of a technical nature in the creation of a sound fiscal policy.

**34228** (ETDE-mf–2711100) **The political and economic problems within the activity range of Soviet energy exports taking into consideration the legal consequences as a result of Soviet output troubles.** Krispien, M. Universitaet der Bundeswehr Muenchen, Neubiberg (Germany). Fakultaet fuer Sozialwissenschaften. [1991] 730p. (In German). Order Number DE92711100. Source: OSTI; NTIS (US Sales Only).

This is the first time comprehensive investigations are carried out concerning economic, political and safety aspects of Soviet energy exports and simultaneous interactions with importing countries taking into account the national energy potentials and the importing countries energy diversification possibilities. The legal problems in connection with output interruptions in Soviet energy exports are dealt with in detail. A one-sided view of Soviet energy exports into COMECON states or Western countries, disregarding - knowingly or unknowingly - other relevant energy factors, has led repeatedly to misunderstandings and disputes, in some cases deliberately against better judgments. The thesis investigates the Soviet energy export outlook with a view to Western industrialized countries as well as to Eastern partner countries, in order to present on the one hand the problematic nature of conflicts in an interrelated context, and on the other hand to offer solutions to conflicts during reoccurring energy crises, making Soviet actions in connection with appropriate constellations more predictable and calculable. (orig./UA).

**34229** (GB–381) **Annual report 1989.** Oxford Institute for Energy Studies (United Kingdom). 1989 58p. Order Number DE92713271. Source: OSTI; NTIS (US Sales Only).

A very wide range of research was pursued at the Oxford Institute for Energy Studies during 1989. The various projects are grouped together here under a number of broad subject headings,

in order to present a broad picture of the work. The majority of the staff during the year were working on various aspects of the effects of changes in the level of oil prices. Other research areas were: energy demand and supplies, forward and future markets, the econometric modelling of oil exploration and development, energy and the environment, and the economic adjustment of oil-exporting developing countries. (author).

## 2903 Environment, Health, and Safety

*Refer also to citation(s) 33717, 33739, 33740, 33741, 33742, 33743, 33744, 33745, 33784, 33808, 34250, 34251, 34344, 35013, 35018, 35020, 35029, 35082, 35086*

**34230** (ES/ESH–18/V1) **Oak Ridge Reservation environmental report for 1990: Volume 1: Narrative, summary, and conclusions.** Wilson, A.R. (ed.). Oak Ridge Y-12 Plant, TN (United States); Oak Ridge National Lab., TN (United States); Oak Ridge K-25 Site, TN (United States). Sep 1991. 310p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-84OS21400 ;AC05-84OT21400. Order Number DE92000406. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to provide information to the public about the impact of the US Department of Energy's (DOE's) facilities located on the Oak Ridge Reservation (ORR) on the public and the environment. It describes the environmental surveillance and monitoring activities conducted at and around the DOE facilities operated by Martin Marietta Energy Systems, Inc. Preparation and publication of this report is in accordance with DOE Order 5400.1. The order specifies a publication deadline of June of the following year for each calendar year of data. The primary objective of this report is to summarize all information collected for the previous calendar year regarding effluent monitoring, environmental surveillance, and estimates of radiation and chemical dose to the surrounding population. When multiple years of information are available for a program, trends are also evaluated. The first seven sections of Volume 1 of this report address this objective. The last three sections of Volume 1 provide information on solid waste management, special environmental studies, and quality assurance programs.

**34231** (ES/ESH–18/V2) **Oak Ridge Reservation Environmental report for 1990: Volume 2: Data presentation.** Wilson, A.R. (ed.). Oak Ridge Y-12 Plant, TN (United States); Oak Ridge National Lab., TN (United States); Oak Ridge K-25 Site, TN (United States). Sep 1991. 281p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-84OS21400 ;AC05-84OT21400. Order Number DE92000407. Source: OSTI; NTIS; INIS; GPO Dep.

The first two volumes of this report are devoted to a presentation of environmental data and supporting narratives for the US Department of Energy's (DOE's) Oak Ridge Reservation (ORR) and surrounding environs during 1990. Volume 1 includes all narrative descriptions, summaries, and conclusions and is intended to be a "stand-alone" report for the ORR for the reader who does not want to review in detail all of the 1990 data. Volume 2 includes the detailed data summarized in a format to ensure that all environmental data are represented in the tables. Narratives are not included in Vol. 2. The tables in Vol. 2 are addressed in Vol. 1. For this reason, Vol. 2 cannot be considered a stand-alone report but is intended to be used in conjunction with Vol. 1.

**34232** (ES/ESH–18/V3) **Paducah Gaseous Diffusion Plant Environmental report for 1990: Volume 3.** Counce-Brown, D. (ed.). Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States); Paducah Gaseous Diffusion Plant, KY (United States). Sep 1991. 294p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-76OR00001. Order Number DE92000405. Source: OSTI; NTIS; INIS; GPO Dep.

This two-part report, Paducah Gaseous Diffusion Plant Site Environmental Report for 1990, is published annually. It reflects the results of a comprehensive, year-round program to monitor the impact of operations at Paducah Gaseous Diffusion Plant (PGDP) on the area's groundwater and surface waters, soil, air quality, vegetation, and wildlife. In addition, an assessment of the effect of PGDP effluents on the resident human population is made. PGDP's overall goal for environmental management is to protect the environment and PGDP's neighbors and to maintain full compliance with all current regulations. The current environmental strategy is to identify any deficiencies and to develop a system to resolve them. The long-range goal of environmental management is to minimize the source of pollutants, to reduce the formation of waste, and to minimize hazardous waste by substitution of materials.

**34233** (ES/ESH–18/V4) **Portsmouth Gaseous Diffusion Plant Environmental report for 1990: Volume 4.** Counce-Brown, D. (ed.). Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States); Martin Marietta Energy Systems, Inc., Piketon, OH (United States). Sep 1991. 230p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC05-76OR00001. (POEF–2070). Order Number DE92000404. Source: OSTI; NTIS; INIS; GPO Dep.

This calendar year 1990 annual report on environmental surveillance of the US Department of Energy's (DOE's) Portsmouth Gaseous Diffusion Plant (PORTS) and its environs consists of two parts: the summary, discussion, and conclusions (Part 1) and the data presentation (Part 2). The objectives of this report are as follows: report 1990 monitoring data for the installation and its environs that may have been affected by operations on the plant site, provide reasonably detailed information about the plant site and plant operations, provide detailed information on input and assumptions used in all calculations, provide trend analyses (when appropriate) to indicate increases and decreases in environmental impact, and provide general information on plant quality assurance.

**34234** (ETDE-mf–2704460) **A consideration of concrete environmental-political measures in the 'Bielefeld Model'.** Universitaet Bielefeld, Fakultaet fuer Wirtschaftswissenschaften. Diskussionsarbeit. Frohn, J.; Bockermann, A.; Faust, A. Bielefeld Univ. (Germany). Fakultaet fuer Wirtschaftswissenschaften. May 1990 29p. (In German). Order Number DE92704460. Source: OSTI; NTIS (US Sales Only).

The 'Bielefeld Model', a disaggregated, econometric model for the FRG, deals with the economic effects of environmental-political measures. The study aims to test the use of the Bielfeld Model in analyzing the economic effects of concrete environmental-political measures. There is first a discussion of the way in which such a measure can be introduced to the model and looked at over changes in variables and parameters. The inclusion of the measure for 'Waste reduction through a change-over in drinks packaging to reusable bottles' is meant to clarify this process and at the same time offer the possibility of testing the simulation results as to their plausibility. On the whole it can be stated that the results of this experiment making use of the Bielefeld Model in connection with the effects of environmental-political measures on economic growth seem worthwhile. (orig./HSCH).

**34235** (ETDE-mf–2714401) **Municipal environmental impact statements. A comparative evaluation of five exemplary environmental impact statement models.** Gesamthochschule Kassel, Wissenschaftliches Zentrum Mensch-Umwelt-Technik. Arbeitsbericht. Grolms, C.; Schulz-Vonderscher, C. Kassel Univ. (Gesamthochschule) (Germany). Wissenschaftliches Zentrum Mensch-Umwelt-Technik (WZ III). Jun 1989 80p. (In German). Order Number DE92714401. Source: OSTI; NTIS (US Sales Only).

In 1988 the Scientific Center III (WZ III), Gesamthochschule Kassel, started a project dealing with the development and realization of an environmental impact statement concept for northern Hesse communities. The first step put into practice was an empirical investigation which analyzes the different environmental impact statement methods by collecting information in five selected German cities (Wiesbaden, Freiburg, Karlsruhe, Erlangen and Ludwigsburg). Details on the origin and development of environmental impact statements are followed by a description of the investigation's underlying motives and methods and a presentation of the results from analyses and evaluations. On the whole, there are no major differences between the individual models. Environmental impact statements generally assess the effects of projects on the environment. They are mainly considered project-accompanying

tools for a better preparation of decisions. A comprehensive appendix compiles minutes, environmental impact statement concepts, documents, and other materials. (orig./HSCH).

**34236** (NEI-DK–632) **Experience gained and an evaluation of the campaign "Our common future": Halfway report.** Larsen, J.H.; Laessoee, J. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Tvaerfaglig Center. Jan 1991 24p. (In Danish). Contract ENS-UVE-90.0160. Order Number DE92703870. Source: OSTI; NTIS (US Sales Only).

A halfway evaluation of the Danish campaign "Our Common Future" aimed at informing the public on environmental protection and what they can do to increase it. The emphasis is laid on subsidized local projects and the interplay between central and local activities. It was observed that children and young people were given priority as target groups. The level of activity was seen as satisfactory, though insufficient resources have resulted in some limitations. Networks have not always functioned efficiently. Global and more complex aspects have not been sufficiently dealt with. Recommendations for improvements are also given. (AB).

## 2904 Energy Resources

*Refer also to citation(s) 34271, 34393, 35557*

**34237** (NEI-DK–636, pp. 13-14) **The energy situation in Norway.** Gjoelsjoe, S. (Norwegian Forest Research Institute, Division of wood science and technology, Aas-NLH (NO)). Skovteknisk Inst., Copenhagen (Denmark). 1990. 35p. (In Danish). (CONF-9003293–: IEA/BA TASK 6, activity 4 meeting, Firenze (Italy), 19-21 Mar 1990). In *Comminution, storage and drying of wood fuels*. Order Number DE92703880. Source: OSTI; NTIS (US Sales Only).

A very brief summary of the current energy situation in Norway concentrating of fuel resources and planned research in the area of wood fuels. (AB).

## 2905 Research, Development, Demonstration, and Commercialization

*Refer also to citation(s) 33620, 33678, 33684, 33687, 33688, 33691, 33707, 33708, 33713, 33846, 33875, 33877, 33878, 33879, 33880, 33881, 33882, 33883, 33884, 33885, 33890, 33902, 34254, 34255, 34256, 34257, 34258, 34326, 34393, 35480, 35504, 35517, 35558*

**34238** (BNL–52284, pp. 193-195) **Workshop group B - Education and technology transfer.** Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop*. 235p. Order Number DE91012127. Source: OSTI; NTIS.

Discussion began on the subject of what organization has credibility to serve as a central focus for education and technology transfer. It was pointed out that 93% of consumers believe what service people tell them. Another consideration was the need to create a motivating factor in consumers, e.g. the energy crisis. This requires an increase in prices over what they have seen recently. A discussion of the Oil Heat Technology Transfer Plan was then begun. In this plan, oil heat research organizations and equipment manufacturers meet regularly to discuss oil heat technology advances. The service technicians are the primary interface to the homeowner; properly trained, they will be in a position to explain to their customers why they should opt for the best cost-effective choices in high-efficiency equipment and upgrades.

**34239** (BNL–52284, pp. 200-202) **Workshop group D - New applications for low-firing-rate oil burners.** Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop*. 235p. Order Number DE91012127. Source: OSTI; NTIS.

While the primary focus of the group was the potential for low-firing-rate equipment, important points were raised related to burner technology in general. The following market sectors were identified as the most important for low-firing-rate burners: (1) furnaces in the 20 to 30 thousand Btu/h range for new, well insulated homes; (2) high efficiency water heaters; (3) truck space heaters; (4) military applications. It was generally expressed that the oil heating industry would benefit from burners which are cleaner and which are more tolerant of low quality fuels. These are perceived as the least attractive aspects of oil heat and very important issues in oil heat's competitiveness.

**34240** (CONF-9006366–Summ.) **HICC 1990 Latin American energy forum: Final report and synopsis.** Dorman, F. Houston Interamerican Chamber of Commerce, TX (United States). [1990]. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI01-90IE10851. From Houston Interamerican Chamber of Commerce (HICC) 1990 Latin American energy forum: Houston, TX (United States); 26-27 Jun 1990. Order Number DE91017950. Source: OSTI; NTIS; GPO Dep.

The objectives of the Forum were to bring together senior industry leaders and energy government officials of Latin America and the United States to explore new business opportunities and enhance trade relations between energy forum participants. The Forum focused on the economic and energy outlook of the countries, legislative and/or administrative changes which have an impact on foreign company relations, including concession policies and other joint venture arrangements. Additionally, the Latin American Energy Forum was designed to present the energy needs of the national oil companies of Latin America for United States oil equipment, service and technology as well as to project long-term expansion of development plans providing new and attractive investor opportunities for US businesses. The goal of the first Latin American Energy Forum was to provide a comfortable, friendly business environment in which each country or state-owned oil firm could project and overview of the country's energy outlook and/or most important energy matters at present, providing each speaker the viable option to customize his or her presentation to best suit the immediate needs of the featured Latin American country. By allowing a broad-base of optional subjects to be presented in an informal structure, the Houston Interamerican Chamber of Commerce (HICC) felt this approach for the first Energy Forum in Houston would open doors for a return visit by the Latin American delegation for future energy conferences organized.

**34241** (DOE/CE/30844–T3) **[Technical and engineering support for the Office of Industrial Programs]: Final report.** Meridian Corp., Alexandria, VA (United States). [1991]. 63p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-86CE30844. Order Number DE92000192. Source: OSTI; NTIS; GPO Dep.

As of April 19, 1991, technical, operational and analytic support and assistance to the offices and divisions of the Office of Renewable Energy, under contract DE-AC01-86CE30844 was completed. The overall work effort, initiated February 20, 1986, was characterized by timely, comprehensive, high quality, professional responsiveness to a broad range of renewable energy program operational support requirements. These are no instances of failure to respond, nor unacceptable response, during the five-year period. The technology program areas covered are Solar Buildings Technology, Wind Energy Technology, Photovoltaic Energy Technology, Geothermal Energy Technology, Biofuels and Municipal Waste Technology, Solar Thermal Technology, Hydropower Energy Technology, Ocean Energy Technology, and Electric Energy Systems and Energy Storage. The analytical and managerial support provided to the office and staff of the Deputy Assistant Secretary for Renewable Energy enabled a comprehensive evaluation of program and policy alternatives, and the selection and execution of appropriate courses of action from amongst those alternatives. Largely through these means the Office has been able to maintain continuity and a meaningful program thrust through the vacillations of policies and budgets that it has experienced over that it has experienced over the past five years. Appended are summaries of support activities within each of the individual technology program areas, as well as a complete listing of all project deliverables and due-dates for each submittal under the contract.

**34242** (DOE/ER–0507P) **Office of Basic Energy Sciences 1991 summary report: A summary of the organization, mission, and activities.** USDOE Office of Energy Research, Washington, DC (United States). Office of Basic Energy Sciences. Sep 1991. 64p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91019006. Source: OSTI; NTIS; GPO Dep.

Basic research is an important investment in the future and will help the US maintain and enhance its economic strength. The US Department of Energy Office of Basic Energy Sciences (BES) basic research activities, carried out mainly in universities and Department of Energy (DOE) laboratories, are critical to the Nation's leadership in science, for training future scientists, and to fortify the Nation's foundations for social and economic well-being. Attainment of the national goals – energy self-sufficiency, improved health and quality of life for all, economic growth, national security – depends on both technological research achievements and the ability to exploit them rapidly. Basic research is a necessary element for technology development and economic growth. This report presents the Department of Energy's Office of Basic Energy Sciences program. The BES mission is to develop understanding and to stimulate innovative thinking needed to fortify the Department's missions. The program has two distinct interrelated parts: research and facilities operations and development. In the pursuit of forefront research results, BES designs, builds and operates certain large, complex advanced scientific facilities such as neutron sources and synchrotron radiation sources. These facilities not only provide BES with unique instruments, but these instruments are also made available to all qualified users, even those not supported by BES. Thus, the facilities actually leverage a great deal more research from the national effort. The BES program conducts basic research that will most likely help the Nation's long-term energy goals. BES implements a broad strategy for conducting basic research and contributes strongly towards national energy goals and to national goals of maintaining and enhancing scientific leadership, technological innovation, and economic strength.

**34243** (EGG-M–91113) **Technology needs for manned Mars missions.** Buden, D. (EG and G Idaho, Inc., Idaho Falls, ID (United States)); Bartine, D. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9109226–15: AIAA/NASA/OAI conference on advanced SEI technologies, Cleveland, OH (United States), 3-4 Sep 1991). Order Number DE91018760. Source: OSTI; NTIS; INIS; GPO Dep.

As members of the Stafford Synthesis Group, we performed an investigation as to the most expeditious manner to explore Mars. To do this, rationale, objectives, requirements and systems definitions were developed. The objectives include the development of the necessary infrastructure and resources for Mars exploration and performing initial successful exploration of Mars. This will include a transportation system between Mars and Earth, habitats for living on Mars, utilization of Martian resources, and the ability to perform exploration over the entire Martian surface. Using the developed architecture, key technologies were identified. 6 figs., 1 tab.

**34244** (ORNL–6661) **Energy Division annual progress report for period ending September 30, 1990.** Selden, R.H. (ed.). Oak Ridge National Lab., TN (United States). Jun 1991. 218p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000414. Source: OSTI; NTIS; GPO Dep.

The Energy Division is one of 17 research divisions at Oak Ridge National Laboratory. The goals and accomplishments of the Energy Division are described in this annual progress report for FY 1990. The Energy Division is a multidisciplinary research organization committed to (1) increasing the knowledge and understanding of how societies make choices in energy use; (2) improving society's understanding of the environmental, social, and economic implications of technological change; (3) developing and transferring energy efficient technologies; and (4) developing improved transportation planning and policy. Disciplines of the 129 staff members include engineering, social sciences, physical and life sciences, and mathematics and statistics. The Energy Division's programmatic activities focus on three major areas: (1) analysis and assessment, (2) energy conservation technologies, and (3) military transportation systems. Analysis and assessment activities cover energy and resource analysis, the preparation of environmental assessments and impact statements, research on waste management, analysis of emergency preparedness for natural and technological disasters, analysis of the energy and environmental needs of developing countries, technology transfer, and analysis of civilian transportation. Energy conservation technologies include building equipment (thermally activated heat pumps, chemical heat pumps, refrigeration systems, novel cycles), building enveloped (walls, foundations, roofs, attics, and materials), retrofits for existing buildings, and electric power systems. Military transportation systems concentrate on research for sponsors within the US military on improving the efficiency of military deployment, scheduling, and transportation coordination. 48 refs., 34 figs., 7 tabs.

**34245** (SAND–91-1840) **Technology transfer in the national laboratories.** Yonas, G. Sandia National Labs., Albuquerque, NM (United States). Aug 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-910357–1: March meeting of the American Physical Society (APS), Cincinnati, OH (United States), 18-22 Mar 1991). Order Number DE92000592. Source: OSTI; NTIS; GPO Dep.

The title of this paper might unfairly provoke readers if it conjures up visions of vast stores of high-tech gadgets in several hundred "technology warehouses" (also known as federal laboratories) around the country, open for browsing by those in search of a bargain. That vision, unfortunately, is a mirage. The term "technology transfer" is not really as accurate as is the term "technology team-work," a process of sharing ideas and knowledge rather than widgets. In addition, instead of discussing the efforts of more than 700 federal labs in the US, I mean to address only those nine government-owned, contractor-operated multiprogram labs run by the Department of Energy. Nevertheless, the topic of technology team-work opportunities with DOE multiprogram national lab is of significance to those concerned with increasing economic competitiveness and finding technological solutions to a host of national problems. A significant fraction of US R&D capabilities rests in the nine DOE multiprogram national laboratories – and these labs have only just begun to join the other federal laboratories in these efforts due to the passage and recent implementation of the National Competitiveness Technology Transfer Act of 1989.

**34246** (VTT-TIED–1215) **Publication catalogue of the Technical Research Centre of Finland in 1990.** Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1991. 331p. (In Finnish, Swedish, English) Order Number DE92704023. Source: OSTI; NTIS (US Sales Only).

The catalogue contains information about VTT's publication activities in 1990. 188 titles were published in VTT's publication series (Publications, Research Reports, Research Notes and VTT Symposium). The Yearbook of the research register was compiled in Finnish and in Swedish of ongoing public research projects. The English versions of the projects and publications in the construction field were separately compiled. 1883 articles, conference papers, etc. written by the personnel of VTT were published elsewhere. Publications are listed per activity unit. The publications of each acivity unit have been classified into following groups: scientific publications, conference papers, publication series of VTT, and other publications. The publications are listed by groups in alphabetical order according to the first author with the exception of VTT's publications which are listed according to serial numbers. The catalogue is included supplements to the publication catalogue 1989. All the publications have a consecutive number in parentheses. At the end of the catalogue there are an alphabetical author index, and a keyword index in English about VTT's own series. In the indices references are made to the consecutive numbers.

## 2906 Nuclear Energy

*Refer also to citation(s) 34030, 34031, 34032, 34035, 34036, 35557*

**34247** (EGG-M–91352) **Nuclear technologies for Moon and Mars exploration.** Buden, D. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1991]. 7p. Sponsored by USDOE, Washington,

DC (United States). DOE Contract AC07-76ID01570. (CONF-9110217–1: 42. International Aeronautical Federation Congress (IAEFC), Montreal (Canada), 7-11 Oct 1991). Order Number DE91018832. Source: OSTI; NTIS; INIS; GPO Dep.

Nuclear technologies are essential to successful Moon and Mars exploration and settlements. Applications can take the form of nuclear propulsion for transport of crews and cargo to Mars and the Moon; surface power for habitats and base power; power for human spacecraft to Mars; shielding and life science understanding for protection against natural solar and cosmic radiations; radioisotopes for sterilization, medicine, testing, and power; and resources for the benefits of Earth. 5 refs., 9 figs., 3 tabs.

## 2910 Conservation

*Refer also to citation(s) 34244, 34341, 34377, 34393, 35490*

**34248** (KTM/E-B–100) **The main report of the energy conservation project: Final report.** Lepistoe, A. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoe- ja automaatiotekniikan Lab.). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 131p. (In Finnish). Order Number DE92703970. Source: OSTI; NTIS (US Sales Only).

It seems to be possible to freeze the growth of total energy consumption but within next 10 - 20 years it is very hard aim if the national economy is growing as expected. The turn down of the end-use consumption of fuels seems to be quite easy to carry out. The freezing of electricity consumption seems not to be possible within next 10 - 20 years even if all energy conservation potential could be taken into use. The freezing of $CO_2$ by making the end-use and the energy production more efficient seems to be almost impossible if the new power capacity is based on fossil fuels. In this report the energy conservation has been dealt from the energy economy milieu economy and consumer point of views. This report offers methods for future conservation measures and conservation studies. This report is based on some 15 substudies.

**34249** (LBL–29830) **Energy use and conservation in the USSR: Patterns, prospects, and problems.** Schipper, L.; Cooper, R.C. Lawrence Berkeley Lab., CA (United States). Apr 1991. 61p. Sponsored by USDOE, Washington, DC (United States); Environmental Protection Agency, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000664. Source: OSTI; NTIS; GPO Dep.

We present an extensive analysis of the structure and intensity of energy use in the USSR since 1960. After a brief review of the energy supply situation in the USSR we analyze sectoral and subsectoral activity in the industrial, transportation, residential, and services sectors. The Soviet Union produces more steel and cement, and ships far more freight, per unit of income, than Western Countries. But Soviet citizens have less space in their homes and in the service sector, fewer appliances, far fewer cars, and travel only one-third as much as their Western counterparts. A comparison of the energy intensities of key activities in the USSR with those of Western countries, shows that in most cases the Soviet Union uses more energy than Western countries per unit of activity. However, we reject aggregate measures as tools for analyzing the past evolution of Soviet energy use, or for predicting energy use in the future. This is because both the structure of the Soviet economy and the intensities of energy uses in the USSR differ so greatly from Western experience. The opportunities for energy conservation in the Soviet Union are truly enormous. Were the energy intensities of the major activities in the USSR to fall to the levels of Western Europe, energy use in the USSR would in 1985 would have been 1/3 lower than it actually was. But there are many barriers to the realization of these savings. The problems in obtaining increased efficiencies are more institutional than technical: the USSR has had little economic incentive to invest in more efficient energy use. Energy prices determined by a central pricing authority have not kept pace with world energy prices or domestic energy production. The dilemma for the Soviet Union is that energy inefficiency is really a product of all the other inefficiencies in the Soviet economy.

## 2920 Supply, Demand, and Forecasting

*Refer also to citation(s) 34351, 34371, 34410, 35001, 35557*

## 2930 Policy, Legislation, and Regulation

*Refer also to citation(s) 34410, 35490*

**34250** (DOE/EH–231-005/0991) **The mixture rule under the Resource Conservation and Recovery Act: RCRA Information Brief, September 1991.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Office of Environmental Guidance. Sep 1991. 1p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

Under the Resource Conservation and Recovery Act (RCRA), wastes may be classified as hazardous wastes or solid (non-hazardous) wastes. Each classification of wastes has its own applicable handling requirements. In accordance with the definition of hazardous waste under RCRA, waste mixtures containing a hazardous and solid waste component are hazardous wastes, unless certain exceptions apply. The primary purpose of the RCRA waste mixture provisions are to ensure that the Subtitle C (hazardous waste) requirements are applied consistently to both hazardous wastes and waste mixtures. These provisions were intended to discourage the commingling of the hazardous wastes with non-hazardous solid wastes simply to avoid Subtitle C regulation.

**34251** (LA-UR–91-3058) **Dealing with duplicate regulations and conflicting jurisdictions.** Aamodt, P.L. Los Alamos National Lab., NM (United States). [1991]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9110223–1: Mixed waste regulation, Albuquerque, NM (United States), 2-3 Oct 1991). Order Number DE92000189. Source: OSTI; NTIS; INIS; GPO Dep.

There are a number of situations where mixed wastes are regulated by dual regulations and regulators. This presentation attempts to show where such duplication exists and how it evolved historically through legislative actions. The presentation includes a discussion of strategies that have been used to deal with the problems that result from duplicate regulations and jurisdictional conflicts. The RCRA and AEA regulations are really more similar than dissimilar. There are significant issues that must be worked through with the regulators. It is most important to work with your regulators early in process. The following are suggestions for dealing with the regulators. (1) Know the regulations in advance of discussions. (2) Begin dialogue with the regulator(s) as early as possible and get to know the people you will be dealing with – and let them know you. (3) Explain the technical/regulatory issues/problems that you face at your facility in sufficient detail that they are clearly understood, and work with the regulator(s) to reasonably address them in the language/requirements of the permit. (4) Always attempt to comply with the regulations first before going in with a variance request – document your efforts, and be honest with your assessment of issues. (5) Don't be adversarial – remember that the regulator has the same objectives as you do. 1 tab.

## 2940 Fossil Fuels

*Refer also to citation(s) 33548, 33620, 33642, 33663, 33664, 33665, 33666, 33678, 33684, 33687, 33688, 33691, 33707, 33708, 33713, 34227, 34260, 35557*

**34252** (DOE/EIA–0035(73-88)) **Historical monthly energy review, 1973–1988.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 17 Sep 1991. 311p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000167. Source: OSTI; NTIS; GPO; GPO Dep.

This publication presents monthly and annual data from 1973 through 1988 on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities. 55 tabs.

**34253** (DOE/EIA–0035(91/09)) **Monthly energy review, September 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 26 Sep 1991. 156p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000458. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

This publication presents current data on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities. 36 figs., 57 tabs.

**34254** (DOE/METC–91/6117, pp. 299) **The Geoscience Center at METC.** Mroz, T.H. (Morgantown Energy Technology Center, WV (USA)); Lopez, R.J. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

The focal point of research activities on gas projects at METC is the Geoscience Center, which houses the tools and data to evaluate conventional, unconventional, and speculative gas resources in the US as sources for future gas resources. The Center's capabilities are designed to meet the present and future needs of projects as outlined in the gas plan. Specific project problems being addressed include the evaluation of horizontal drilling sites and techniques for reservoir characterization. Production performance analyses have been started and will be improved upon using an integration of geotechnical data and software to formulate models of the reservoirs. Data base activities concentrate on the standardization and transfer of present paper and magnetic media to optical and magneto-optical media for more efficient access and processing. Technology transfer is a continuing effort using present and innovative mechanisms such as optical disk, computer assisted 3.D modeling, and video displays to communicate information and results to ultimate users. This information is structured for the dual purpose of (1) providing general technical support for independents and other companies, and (2) for implementation of specific exploration and prodution technologies tailored to a particular region.

**34255** (DOE/METC–91/6117, pp. 300) **Eastern gas analysis - A systems approach.** Zammerilli, A.M.; Layne, A.W. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

Eastern Gas Systems Analysis studies are being performed to determine the conditions under which gas produced through application of advanced technologies is economically attractive. For advanced technologies such as horizontal drilling in the Devonian shales, these conditions are determined through the use of geologic screening and computer simulations of gas production, reservoir stimulation, and economic-risk analysis. Conditions for attractive economics include acceptable profitability/rate of return (ROR), and increased market share for the gas. METC is developing a market share analysis methodology to identify the overcome barriers that prevent advanced technologies from increasing their gas share in the electric utility market. Competitive prices and profitability are potentially significant barriers. This methodology uses probabilistic economic analysis to quantify risk and provide more insight into the actual profitability. The current focus is on examining horizontal well economics for eastern Devonian shales and probabilistic techniques to address profitability.

**34256** (DOE/METC–91/6117, pp. 305-306) **Western tight gas sands research.** Smith, A.C. (Morgantown Energy Technology Center, WV (USA)); Pool, S.E.; Thomas, M.H. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

This poster session displays several of the projects completed during the past year as part of the METC in-house research on the Western Gas Sands Project. The first project's objective was to evaluate the effectiveness of the computerized technique of coplanar lineament analysis in the exploitation of natural gas from tight sandstones. It was thought that the lineaments could be an aid in locating subsurface fractures, which would enhance the production of gas from sandstones with low matrix permeability. The second project originated from work done for the coplanar lineament analysis. Since vertical wells to the Mancos B are uneconomical over much of the Douglas Creek Arch, a horizontal wellbore is suggested as a possible means of economically developing the natural gas in the Mancos B sandstone. This project is concerned with finding the best locations for a horizontal well. The third project points out that horizontal well technology can also be applied to develop tight blanket gas sandstones in the Greater Green River Basin. The objective of the fourth project was to determine the amount of gas produced from tight gas sands in the states of Wyoming, Utah, Colorado, New Mexico, and Montana.

**34257** (DOE/METC–91/6117, pp. 316-323) **Natural gas recovery/utilization SBIR program.** Shoemaker, H.D. USDOE Morgantown Energy Technology Center, WV (United States). Nov 1990. (CONF-901117–: Natural gas research and development contractors review, Morgantown, WV (United States), 14-15 Nov 1990). In *Proceedings of the natural gas research and development contractors review meeting.* 347p. Order Number DE91002035. Source: OSTI; NTIS.

In the 1990 DOE SBIR solicitation, the natural gas topic was Advanced Technology for the Recovery and Utilization of Natural Gaqs. The subtopics were (1) Advanced Geoscience and Geotechnology for Application to Low-Permeability Formations, (2) Advanced Geoscience and Geotechnology for Recovery of Additional Gas From Existing Reservoirs, (3) Advanced Instrumentation and Interpretation Techniques for Locating and Characterizing Natural Gas Reservoirs, and (4) Advanced Concepts for Natural Gas Conversion, Transportation and/or Utilization. Natural gas research projects awarded under the SBIR Program and managed by METC are discussed below by the award year, beginning in 1988.

## 2960 Electric Power

*Refer also to citation(s) 33862, 33923, 34028, 34219, 34227, 34252, 34253, 34266, 34267, 34268, 34269, 34331, 34402, 34410, 35029, 35557*

**34258** (DOE/BP–1418) **Research and Development report: Fiscal years 1989 and 1990.** USDOE Bonneville Power Administration, Portland, OR (United States). Office of the Assistant Administrator for Engineering. Aug 1991. 63p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000884. Source: OSTI; NTIS; GPO Dep.

Since the 1940s, the Bonneville Power Administrative (BPA), has sought to advance an efficient system to provide the Pacific Northwest region with safe, reliable, and cost-effective electrical power. Research and development (R&D) activities support that mission. Each biennium, R&D managers issue a digest report of the various programs and activities in each of the technological arenas. The report covers a few projects, considered as yielding particularly significant results, as spotlights. Others are described less fully; in some cases with a simple annotation. The report's divisions correspond to the major categories of R&D projects: fish and wildlife, energy resources, and transmission technology. 18 figs., 4 tabs.

**34259** (DOE/BP–1661) **Electricity Use in the Pacific Northwest: Utility historical sales by sector 1990 and preceding years.** USDOE Bonneville Power Administration, Portland, OR (United States). Jun 1991. 108p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000885. Source: OSTI; NTIS; GPO Dep.

This report officially releases the compilation of regional 1990 retail customer sector sales data by the Bonneville Power Administration. The report is intended to enable detailed examination of annual regional electricity consumption. It also provides observations based on statistics covering the 1983–1990 time period, and gives statistics covering the time period 1970–1990. The electricity use report is the only information source that provides data obtained from each utility in the region based on the amount of electricity they sell annually to four sectors. Data is provided on each retail customer sector and also on the customers Bonneville serves directly: residential, commercial, industrial, direct-service industrial, and irrigation. 21 figs., 40 tabs.

**34260** (DOE/EIA–0035(91/08)) **Monthly energy review, August 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. 26 Aug 1991. 137p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91017877. Source: OSTI; NTIS; GPO; GPO Dep.

This publication presents current data on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities.

**34261** (DOE/EIA–0226(91/09)) **Electric Power Monthly, September 1991.** USDOE Energy Information Administration, Washington, DC (United States). Office of Coal, Nuclear, Electric and Alternate Fuels. 12 Sep 1991. 200p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000083. Source: OSTI; NTIS; GPO; GPO Dep.

This publication provides monthly statistics at the national, Census division, and state levels for net generation, fuel consumption, fuel stocks, quantity and quality of fuel, cost of fuel, electricity sales, revenue, and average revenue per kilowatthour of electricity sold. Data on net generation, fuel consumption, fuel stocks, quantity and cost of fuel are also displayed at the North American Electric Reliability Council (NERC) region level. Additionally, statistics at the company and plant level are published in the EPM on capability of new plants, net generation, fuel consumption, fuel stocks, quantity and quality of fuel, and cost of fuel. 4 figs., 63 tabs.

**34262** (ETDE-mf–2714390) **PreussenElektra. Annual report of the activities from January 1, 1990 to December 31, 1990.** Preussische Elektrizitaets-AG (Preussenelektra), Hannover (Germany). 1991 83p. (In German). Order Number DE92714390. Source: OSTI; NTIS (US Sales Only).

The tasks and activities of this large affiliated company of the power supply sector are reviewed for 1990, including a multitude of financial data (e.g. balance sheet, profit-and-loss account, etc.). (UA).

**34263** (SERI/CP–250-4254-Vol.2, pp. 209-230) **Externalities in electric generation planning and development - A California status report.** Jenkins, A. (California Energy Resources Conservation and Development Commission, Sacramento (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

Externalities have had an important role in California energy policy since the formation of the California Energy Commission in 1974. For example, the Warren-Alquist Act establishing the Commission requires that the planning and approval of new energy resources balance requirements of growth with protection of public health, environmental quality, and conservation of resources. Similarly, a recent amendment to the Warren-Alquist Act requires the Energy Commission to include values for costs and benefits to the environment in minimizing the costs of energy services, and to encourage diversity through renewable energy technologies. These requirements motivate increasingly detailed valuations of externalities, and expression of the valuations in commensurate monetary units. This presentation examines California's work in this area.

**34264** (SERI/CP–250-4254-Vol.2, pp. 249-273) **Opportunities for renewable energy systems on military bases.** Leigh, G.G. (Univ. of New Mexico, Albuquerque (USA)). Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2.* 317p. Order Number DE91013767. Source: OSTI; NTIS.

The US Department of Defense (DoD) operates more than 800 military bases, stations, and other installations at locations all over the world. Many of these bases are comparable to small cities with similar energy requirements and environmental issues overlaid with the needs of military operations. The total annual energy consumption for the DoD is more than 1.85 quads costing in excess of $10 billion per year. Over one-third is consumed in the operation of facilities and utilities. Several new pieces of legislation and supporting regulations have emerged that both mandate further reductions in energy consumption and cost for military bases and also urge the use of renewable and alternative energy systems. These documents enhance the opportunities for private investors in renewable energy systems. This presentation will explain how military bases are comparable to small cities and how they differ, it will describe some of the energy/environmental difficulties currently being faced by military base managers, and then will describe some of the opportunities for employing renewable energy systems to help solve some of these difficulties. It will then describe where some of the opportunity locations are, what types of renewable systems might be used at these locations, and what are some of the obstacles to be overcome in going after these opportunities.

**34265** (WR-B–91-7) **Puget Sound Area imprest funds, Bonneville Power Administration, Portland, Oregon.** USDOE Office of Inspector General, Albuquerque, NM (United States). Western Regional Audit Office. 15 Aug 1991. 13p. Sponsored by USDOE, Washington, DC (United States). Source: OSTI (Free of Charge).

The Bonneville Power Administration (Bonneville) operated and maintained a network of substations and electric transmission lines in the Pacific Northwest. Bonneville used imprest funds at its substations to facilitate small purchases and provide cash advances for travel. Four of those imprest funds were located in Bonneville's Puget Sound Area serving the Seattle, Washington region. The purpose of this audit was to evaluate Bonneville's management of the four imprest funds at substations in Chehalis, Covington, Olympia, and Snohomish, Washington.

## 2980 Consumption and Utilization

*Refer also to citation(s) 34261, 34351, 34411, 35557*

**34266** (DOE/PE/77029–T1) **Validation of key assumptions in the FOSSIL2 model.** Applied Energy Services, Inc., Arlington, VA (United States). 6 Aug 1987. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-85PE77029. Order Number DE91018953. Source: OSTI; NTIS; GPO Dep.

The electrically sector of the FOSSIL2 model has been substantially modified (under Task 8) in order to both update the model and to create a more useful and easier to use analytical tool for various utility analyses. This report will explain in detail the modifications which were needed to improve this sector of the model. The first sub-task under Task 8 was to alter the model's method of accumulating the capacity built by the electric utility industry. Creating a variable in FOSSIL2 to represent accumulated capacity in Btu's/yea would have been one solution to the problem; however, it was worth the extra effort to represent the capacity in megawatts, since megawatts are more widely used by utility analysis. This change makes the model easier to use by both the modeller (in updating the parameters of the model) and the analysts who use in the output. The second sub-task under Task 8 was the addition of dispatching to the electricity sector of the model. The dispatching subsector of the model does not try to simulate variations in each utility's load on a daily or seasonal basis, which is impossible to do in an aggregate national model. Instead it attempts to capture the variations in fuel use and capacity factors for the entire industry on an annual basis by creating a "national" load duration curve. Following is a more detailed description of the changes made to the

electricity sector of the model under Task 8, as well as look at the new output of the model.

**34267** (DOE/PE/77029–T4) **FOSSIL2 electricity sector modifications.** Applied Energy Services, Inc., Arlington, VA (United States). 14 Oct 1987. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-85PE77029. Order Number DE91018956. Source: OSTI; NTIS; GPO Dep.

This report contains tables of modified data pertaining to energy consumption through the year 2010 in the USA. Oil, gas, coal, nuclear energy and synthetic fuels are included. Usage of automobile fuels is included, also. (GHH)

**34268** (DOE/PE/77029–T5) **Final projection tables for the 1987 energy projection reference case.** Applied Energy Services, Inc., Arlington, VA (United States). [1987]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-85PE77029. Order Number DE91018957. Source: OSTI; NTIS; GPO Dep.

There are three basic steps required to extend the FOSSIL2 model so that simulation runs can be executed through the year 2030 instead of only through 2010. The first is purely mechanical in setting up the appropriate computer files. The perform files must be set to run each of the FOSSIL2 and WOIL models to 2030, with the necessary links between them also continued to 2030. The second step involves extending all the time dependent table functions from 2010 to 2030. The final and most difficult step is to make structural and parameter modifications to the model in areas that become important such as synthetic fuels and renewables. The first two steps have been completed as assigned. The third was left as an additional task because it is potentially quite large, depending on the outcome of the simple extension process and on how many model revisions are desired. This report focuses on the second step of the extension process, the extension of the table functions, and its results. Attachment A lists all the time dependent tables that were affected. The values through 2010 are these used in the DOE 1987 projections (with a few exceptions). Many of those tables contain input assumptions that probably should be reevaluated whenever a 2030 base case is developed (for example, the macroeconomic variables, transportation baseline values, dispersed renewables, and Alaskan oil and gas production levels). For the economic variables, a quick survey indicated that few of the major economic forecasters have off-the-shelf projections past 2010. Only the Bureau of Economic Analysis of the US Commerce Department was found to do long range economic projections. Their forecast was only a partial one (GNP, population, earnings, and employment) and seemed somewhat pessimistic, with only 0.9 percent per year GNP growth after 2015. For now the macroeconomic variables to the year 2030 were extrapolated from the current projections to 2010. 14 tabs.

**34269** (DOE/PE/77029–T6) **FOSSIL2 extension to the year 2030.** Applied Energy Services, Inc., Arlington, VA (United States). 26 Sep 1987. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-85PE77029. Order Number DE91018958. Source: OSTI; NTIS; GPO Dep.

The FOSSIL2 model contains numerous variables and assumptions, many of which need to be reviewed periodically. This report lists those variables which have the most impact on the model projections. They have been divided into two groups: those which are explicit assumptions and those which more implicitly contain important assumptions that need to be validated. The sources of data for the first group are rather straightforward. For the second group, data for these key assumptions were researched and then compared to the FOSSIL2 model input used in the Reference Case of the 1987 Energy Projections by the Department of Energy. The sources for this data,and the method used to derive values for these variables are also summarized here. A variable list at the end of this report includes the variable names as they appear in the model, as well as the file in which they are located. This list should help facilitate the use of the report as a reference guide. Validation of the current values in the model made it clear that some work is needed in several sectors in order to update the model to reflect current US energy assumptions. This is especially true in the Electricity Sector and the Coal Sector. The next AES task for the DOE is scheduled to be a modification of the structure and parameters of the Electricity Sector. The updating of the Coal Sector will likely be included in the work scheduled for the next fiscal year. It is hoped that this report will serve as a guidebook for future NEPP use of the model, and will also contribute to the overall understanding of the model's parameters. 13 figs.

**34270** (UCID–19227-90) **US energy flow, 1990.** Borg, I.Y.; Briggs, C.K. Lawrence Livermore National Lab., CA (United States). Jun 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018657. Source: OSTI; NTIS; GPO Dep.

Energy consumption in the US changed only slightly in 1990. Transportation used was close to 1988 and 1989 levels. Improvements in automobile efficiency were compensated by an increase in the number of miles driven. A larger energy use in the industrial sector was offset by decreases in the residential/commercial sector. Energy use in the latter sector was influenced by a relatively mild, nation-wide summer and winter. All end-use sectors were affected by the high fuel prices related to the Kuwait-Iraq war in the last half of the year and by an attendant economic downturn. Electrical use rose slightly and thus deviated from the 3-4% annual increases recorded in the previous decade. Nuclear energy's contribution to electrical generation increased to almost 21%, and capacity factors reached 66%, an all time high in the US. Renewable sources of energy apart from hydroelectric power showed negligible growth. Domestic natural gas and coal production rose, and oil production continued its steady decline. As oil constitutes 41% of US energy consumption, failing domestic production has been augmented by imports. Collectively energy imports constituted two-thirds of the US trade deficit in 1990. The ratio between energy consumption and GNP declined slightly in 1990 as it has for almost every year since 1972. The "Services" component of the GNP increased in 1990 and the "Goods" and "Structures" components declined in keeping with an even longer trend. 29 refs., 7 figs., 4 tabs.

## 2990 Unconventional Sources and Power Generation

*Refer also to citation(s) 33865, 33877, 33878, 33879, 33880, 33881, 33882, 33883, 33884, 33885, 33890, 33902, 33947*

**34271** (DOE/SF/11634–T1) **A guidebook to alternative energy projects on American Samoa, The Commonwealth of the Northern Mariana Islands, The Federated States of Micronesia, Guam, and The Republics of the Marshall Islands and Palau.** Case, C.W. Golden Gate Energy Center, Sausalito, CA (United States); Xavier High School, Moen, Truk (Micronesia). May 1987. 143p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-81SF11634. Contract C60161. Order Number DE91018875. Source: OSTI; NTIS; GPO Dep.

The purpose of this guidebook is to help transfer information concerning alternative energy projects that have been tried on the Pacific islands affiliated with the US. These islands include those in American Samoa, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia (Kosrae, Pohnpei, Truk, and Yap), Guam, and the Republics of the Marshall Islands and Palau. Distances are long between islands and populations are sparse, making communication and the transfer of information particularly difficult. A project that works on American Samoa might be appropriate for Yap, but to get this information to the proper people on Yap in a reasonable period of time is extremely difficult. This book describes 100 alternative energy projects that have been tried on the islands since the mid-1970's. This description and record of what has been done to date should be a source of ideas for energy workers, reduce duplication of work, and help encourage successes by describing other successes and failures. Alternative energy projects are projects that use indigenous, renewable resources in order to reduce local dependency on imported petroleum for electricity or liquid fuels. The islands have an apparent abundance of natural resources for this purpose such as the sun, rivers, vegetation, the ocean, and wind; and, ideally, it should be relatively simple to convert these resources to electricity or fuel. However, there are problems unique to the remote, tropical Pacific that often appear insurmountable, and successes to date are the results of unusual persistence, hard work, and ingenuity of

those on the islands. Projects are confined to those that actually develop or demonstrate hardware. These projects use the complete spectrum of alternative technologies such as biomass conversion, wind electric, solar water heating, photovoltaics, wind water pumping, hydroelectric, water desalination, and integrated systems. 381 refs., 85 figs.

**34272** (KTM/E-B--81) **NEMO Advanced energy systems and technologies: Interim report 1988-1990.** Lund, P. (Helsinki Univ. of Technology, Otaniemi (Finland). Dept. of Technical Physics). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 83p. Project KTM-128/881/87. Order Number DE92703972. Source: OSTI; NTIS (US Sales Only).

Finland's energy research programme Published also in Finnish Report no B:80.

The national energy programme NEMO is the first larger R D effort in the field of new energy systems in Finland.The major objectives are to assess the potential of new energy systems for the Finnish energy supply system, to promote industrial activitities, and to establish research traditions on key areas. Within the NEMO-programme, updated estimates of the potential of new energy technologies have been obtained. Also, more industries are now involved in the technological development than before and active R D groups have been formed around central research fields. Starting with a comprehensive survey of the whole new energy technology field, the NEMO-programme is now focusing on the most promising technologies: wind power, solar energy (mainly photovoltaics), and thermal energy storage. These are already technically mature for demonstration purposes and special applications. Close to one third of the NEMO activities come through private industries. The strongest activity is found in photovoltaics systems where Finland has a few percent of the world markets. In general, areas of competence include remote power applications, pv system technology, wind power subsystems and steel tanks for thermal storage. The solar and wind activities are based on a global strategy. R D results obtained so far have mainly been utilized in remote power and special applications through improved system know-how and new products. For example, a new wind-diesel system and a hydrogen-based storage system are under development.

# 30 DIRECT ENERGY CONVERSION

## 3001 MHD Generators

*Refer also to citation(s) 34530*

**34273** (DOE/ET/15601--40) **Diagnostic development and support of MHD test facilities: Technical progress report, January--March 1990.** Mississippi State Univ., MS (United States). Diagnostic Instrumentation and Analysis Lab. [1990]. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-80ET15601. (FE--15601-40). Order Number DE92000632. Source: OSTI; NTIS: GPO Dep.

The Diagnostic Instrumentation and Analysis Laboratory (DIAL) at Mississippi State University (MSU) is developing diagnostic instruments for Magnetohydrodynamics (MHD) power train data acquisition and for support of MHD component development test facilities. Microprocessor-controlled optical instruments, initially developed for Heat Recovery/Seed Recovery support, are being refined, and new systems to measure temperatures and gas-seed-slag stream characteristics are being developed. To further data acquisition and analysis capabilities, the diagnostic systems are being interfaced with DIAL's computers. Technical support for the diagnostic needs of the national MHD research effort is being provided. DIAL personnel will also cooperate with government agencies and private industries to improve the transformation of research and development results into processes, products and services applicable to their needs. 9 figs., 1 tab.

**34274** (DOE/ID/12735--T18) **Magnetohydrodynamic projects at the CDIF: Quarterly technical progress report, January 1, 1991--March 31, 1991.** MSE, Inc., Butte, MT (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-88ID12735. Order Number DE92000396. Source: OSTI; NTIS; GPO Dep.

This quarterly technical progress report presents the tasks accomplished at the Component Development and Integration Facility (CDIF) during the second quarter of FY91. Areas of technical progress this quarter included: coal system development; seed system development; test bay modification; channel power dissipation and distribution system development; oxygen system storage upgrade; iron-core magnet thermal protection system checkout; TRW slag rejector/CDIF slag removal project; stack gas/environmental compliance upgrade; coal-fired combustor support; 1A channels fabrication and assembly; support of Mississippi State University diagnostic testing; test operations and results; data analysis and modeling; technical papers; and projected activities. 2 tabs.

## 3005 Fuel Cells

*Refer also to citation(s) 33967*

**34275** (DOE/METC--89/6105, pp. 11-18) **EPRI fuel cell program.** Gillis, E.A. (Electric Power Research Inst., Palo Alto, CA (USA)). USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572--: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

This presentation describes the Electric Power Research Institute (EPRI) fuel cell program. It addresses the program strategy for the phosphoric acid, molten Carbonate, and solid oxide fuel cells and the joint agreements with utilities for their commercialization. A description of each of the three types of fuel cells is given along with their current status of commercialization.

**34276** (DOE/METC--89/6105, pp. 21-25) **High temperature solid oxide electrolyte fuel cell power generation system.** USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572--: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

This paper summarizes work being conducted to design, fabricate, and test a 20 kWe tubular solid oxide fuel cell (SOFC) generator. This unit, called the Multi-Kilowatt Generator (MKG), will be largely self-supporting and will be fueled with natural gas and with simulated coal-derived gas. Additional objectives of this program are to identify design requirements for 20 MWe and larger coal-fueled electric power plants, to establish a reference design for a commercial coal-fueled power, and to formulate technology development goals.

**34277** (DOE/METC--89/6105, pp. 26-34) **Solid oxide fuel cell power plants.** Parker, W.G. (Westinghouse Electric Corp., Pittsburgh, PA (USA)). USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-80ET17089. (CONF-890572--: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

This paper summarizes work being conducted to evaluate Integrated Gasification, Solid Oxide Fuel Cell (IG/SOFC) combined cycle power plants. This work represents one task of the contract effort whose purpose is to establish developmental goals for the SOFC technology based upon the requirements for commercial power generation systems. Systems analysis and conceptual design studies are being conducted to define IG/SOFC system arrangements, plant and component design requirements, and economic goals for central station utility power plants. A Reference Design for a 250 MWe IG/SOFC steam turbine combined cycle power plant has been prepared and is presented in this paper.

**34278** (DOE/METC--89/6105, pp. 35-36) **SOFC materials.** Krumpelt, M. (Argonne National Lab., IL (USA)); Bloom, I. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572--: 1. annual fuel cells contractors review

meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

This presentation describes a project to develop new materials for solid oxide fuel cells (SOFC) that will allow them to operate at lower temperatures (600-800C). A lowering of the operating temperature is expected to reduce the failures associated with manufacturing, operating and startup stresses. A status of the current work is given as well a description of the direction of future research.

**34279** (DOE/METC–89/6105, pp. 37-46) **Advanced alternate planar geometry, solid oxide fuel cells.** Khandkar, A.C. (Ceramatec, Inc., Salt Lake City, UT (USA)); Elangovan, S. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-88MC25168. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

A new technique for the fabrication composite electrolyte/electrode matrix has been developed. This composite structure exhibits higher strength, low creep, and stable electrode/electrolyte interface. Alternate cathode materials with higher conductivity than conventional Sr doped $LaMnO_3$ cathode have been developed. An alternate interconnect material is being evaluated. Initial trials with the new interconnect material appear promising.

**34280** (DOE/METC–89/6105, pp. 47-53) **Zirconia-based electrodes for solid oxide fuel cells.** Worrell, W.L. (Univ. of Pennsylvania, Philadelphia (USA)); Liou, Shianshyang. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract FG21-86MC23139. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The objective of this contract is the syntheses and electrical characterization of new mixed-conducting yttria-stabilized zirconia-titania solutions. The results will provide the fundamental data necessary for the quantitative evaluation of the potential electrode applications of these new mixed-conducting oxides in solid oxide fuel cells (SOFC).

**34281** (DOE/METC–89/6105, pp. 54-63) **Alternative materials for solid oxide fuel cells.** Chick, L.A. (Pacific Northwest Lab., Richland, WA (USA)); Bates, J.L.; Weber, W.J. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The purpose of this research is to develop (1) improved materials for use as interconnection and electrode materials in solid oxide fuel cells (SOFC) and (2) synthesis and fabrication processes for air sintering current and alternative materials that can be consolidated in air along with the electrolyte and electrodes into an SOFC. The objectives are to: (1) Improve the electrical, thermal and electrochemical properties of interconnections and electrodes by minimizing the thermal expansion mismatch between the different materials in the SOFC. This is to be accomplished by minimizing or eliminating chemical and electrochemical interactions between these materials, by reducing internal and interface resistances in the SOFC, and by enhancing interface bonding for uniform current flow, increased mechanical strength, and controlled gas permeability. (2) Develop new or improved methods for synthesizing and processing chromite interconnections in air below 1,823 K. The new methods are to result in the reproducible and low-cost fabrication of SOFCs with improved performance. (3) Provide a broader selection of alternative interconnection and electrode materials with improved properties that can be synthesized, fabricated and consolidated in air into SOFC.

**34282** (DOE/METC–89/6105, pp. 67-76) **Monolithic solid oxide fuel cell research.** Minh, N.Q. (Allied-Signal Aerospace Co., Torrance, CA (USA)). USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-88MC25166. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The overall objective of this contract is to identify advancements in monolithic solid oxide fuel cells (MSOFCs) that will contribute significantly to improvement in cell cost and performance for coal-based power generation applications. The specific objectives of the contract are to (1) assess the manufacturing costs for a MSOFC and system costs for a coal-based MSOFC plant. (2) modify electrodes and electrode/electrolyte interfaces to improve the electrochemical performance of the MSOFC, and (3) test the performance of a MSOFC on simulated coal-derived fuels under specified test conditions.

**34283** (DOE/METC–89/6105, pp. 77-81) **Solid state proton conductors.** Jewulski, J. (Inst. of Gas Technology, Chicago, IL (USA)); Osif, T. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-88MC24218. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The primary objective of this work is to gain a better understanding of high temperature solid-state proton conductors (SSPC) and to use that understanding to develop a high conductivity electrolyte for use in solid-state fuel cells and other proton conducting devices.

**34284** (DOE/METC–89/6105, pp. 82-88) **Development of improved cathodes for solid oxide fuel cells.** Anderson, H.U. (Univ. of Missouri, Rolla (USA)); Nasrallah, M. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract FG21-89MC26015. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The University of Missouri-Rolla is conducting a 12 month research program which has as its goal to develop and evaluate improved cathode materials for solid oxide fuel cells (SOFC). The objectives of this program are: The development of cathode materials of improved stability in reducing environments. The development of cathode materials with improved electrical conductivity. The successful completion of this project will lead to a more reliable and better performing high temperature solid oxide fuel cell.

**34285** (DOE/METC–89/6105, pp. 89-93) **Planar solid oxide fuel cell technology cell stack test and evaluation.** Hsu, M. (Ztek Corp., Waltham, MA (USA)). USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

There are four primary objectives of this EPRI Phase 1 contract in evaluating the planar solid oxide fuel cells suitable for scaling to utility applications. (a) Ascertain the material stability by subjecting the components up to 1,000 hours of fuel cell operation at 1,000C. (b) Determine the uniformity of reactant flow through a stack of components, and in the plane of the electrolyte by pressure distribution measurement and fluid dye visualization test. (c) Demonstrate the stack integrity by assessing the effect of a single cell failure on the performance of a fuel cell stack. (d) Demonstrate the performance capability and stability of the planar solid oxide fuel cell stack with gas seals.

**34286** (DOE/METC–89/6105, pp. 94-102) **A moderate temperature carbonate fuel cell.** Kosek, J.A. (Giner, Inc., Waltham, MA (USA)); Giner, J. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC02-87ER80444. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The objective of the authors program is the continued development of the aqueous carbonate fuel cell (ACFC) system. Efforts are being directed toward optimization of system operating parameters and the development of low cost efficient fuel cells and materials. Emphasis is being placed on optimization of fuel cell operating conditions and electrolyte composition and the development of low cost cell hardware components such as catalysts, fuel cell collector/separator components and matrix materials. In addition, efforts are being directed toward development of a fuel cell model and a system analysis.

**34287** (DOE/METC–89/6105, pp. 105-111) **IFC MCFC technology status.** Johnson, W.H. (International Fuel Cells, South Windsor, CT (USA)). USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-87MC23270. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting*. 386p. Order Number DE89011699. Source: OSTI, NTIS.

The objective of this program is to provide a novel, a more efficient and more cost effective molten carbonate fuel cell design to provide electrical power from coal derived gases. The program calls for technical investigation of improved performance, life and cost features as follows: (1) performance improvements were identified which when taken together could increase power density up to 100%; (2) life issues are directed towards limiting the electrolyte migration mechanism which could double the endurance capability of an MCFC stack; (3) cell and component costs improvements were identified which could potentially decrease the manufactured cost projection by 40%.

**34288** (DOE/METC–89/6105, pp. 112-121) **Review of system studies - Task 3 molten carbonate fuel cell technology improvements.** Healy, H.C. (International Fuel Cells, South Windsor, CT (USA)). USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-87MC23270. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting*. 386p. Order Number DE89011699. Source: OSTI; NTIS.

The goal of the DOE and IFC Molten Carbonate Fuel Cell (MCFC) Program is to develop a MCFC technology base capable of providing clean electrical energy at competitive cost when integrated with coal gasification systems. To be successful, a coal-fueled MCFC system must provide cost of electricity (COE) which is lower than that of current electric generation technologies and which is competitive with other long range electric generating systems. Previous MCFC systems studies have highlighted the very high efficiency and significantly lower emissions potential of the MCFC system. However, a detailed power plant conceptual design incorporating a practical MCFC cell configuration, such as IFC has developed recently, had never been conducted. With the recent progress in coal gasification and associated gas stream cleanup, it was considered appropriate to conduct in-depth, detailed analysis of potential coal gasifier/molten carbonate fuel cell systems (CG/MCFC) to prove their competitiveness and to subsequently plan a development path.

**34289** (DOE/METC–89/6105, pp. 122-129) **Corrosion of materials in molten carbonate fuel cells.** Vesely, E.J. Jr. (IIT Research Inst., Chicago, IL (USA)). USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-86MC23265. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting*. 386p. Order Number DE89011699. Source: OSTI; NTIS.

The objectives of this work are to determine and describe the hot corrosion mechanism in MCFC bipolar sheet materials and current collectors and to provide a corrosion model for predicting hot corrosion behavior of metals and alloys in the fuel cell environment. To accomplish these objectives a multiphase program is being run at IITRI and Institute of Gas Technology (IGT). The tests performed in this program are of two types: The first is run in high temperature corrosion retorts with many specimens exposed at the same time. The second is a dual atmosphere type, which exposes one sample to the combined anode-cathode environment. Samples exposed to both test conditions are then analyzed to determine the effect that selected fuel cell variables have on the corrosion mechanism.

**34290** (DOE/METC–89/6105, pp. 130-139) **Development of internal reforming MCFC stack technology.** Bernard, R. (Energy Research Corp., Danbury, CT (USA)); Doyon, J.; Farooque, M.; Patel, P.; Paetsch, L.; Skok, A.; Steinfeld, G. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-87MC23274. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting*. 386p. Order Number DE89011699. Source: OSTI; NTIS.

Stack technology efforts under this two-year extension of the DOE program DE-AC21-87MC23274 are focused on three objectives which will result in evaluation of full size components that are compatible with the coal gas system identified by Energy Research Corporation's subcontractor (Fluor Daniel). These three key stack objectives are: (1) design a coal gas compatible stack, (2) define component development requirements, and (3) design, fabricate, and test representative stacks.

**34291** (DOE/METC–89/6105, pp. 140-150) **MCFC systems, coal-gas based.** Steinfeld, G. (Energy Research Corp., Danbury, CT (USA)); Tanner, A.L.; Kremenik, S.F. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-87MC23274. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting*. 386p. Order Number DE89011699. Source: OSTI; NTIS.

An evaluation was performed to determine the effect of MCFC (Molten Carbonate Fuel Cells) stack operating pressure on COE (Cost of Electricity). MCFC power plants with stack operating pressure at 1, 2, 3 and 10 atmospheres were evaluated. Based on this evaluation atmospheric pressure stack operation was selected.

**34292** (DOE/METC–89/6105, pp. 151-160) **Oxygen electrode in molten carbonate fuel cells.** Dave, B.B. (Texas A and M Univ., College Station (USA)); Adanuvor, P.K.; Enayetullah, M.A.; Srinivasan, S.; White, R.E.; Appleby, A.J. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting*. 386p. Order Number DE89011699. Source: OSTI; NTIS.

An elucidation of the kinetics of oxygen reduction in molten carbonate fuel cell is essential because the overpotential losses are considerably greater at the oxygen cathode than at the hydrogen anode. The objective of the authors study is to determine the kinetic and mass transfer related parameters for oxygen reduction in molten carbonates.

**34293** (DOE/METC–89/6105, pp. 161-182) **Cathode dissolution.** Shores, D.A. (Univ. of Minnesota, Minneapolis (USA)); Selman, J.R.; Ong, E.T. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-86MC23263. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting*. 386p. Order Number DE89011699. Source: OSTI; NTIS.

The purpose of this study is to obtain detailed data on NiO dissolution processes and to incorporate that data, along with other data from the literature, into a sophisticated mathematical model of NiO cathode degradation in MCFCs. Such a model should be able to predict cathode endurance and to provide guidance for designing and operating cells in a manner that would minimize the rate of cathode degradation.

**34294** (DOE/METC–89/6105, pp. 185-193) **Development of a coal-fueled internal manifold heat exchanger (IMHEX) molten carbonate fuel cell stack.** Benjamin, T.G. (Inst. of Gas Technology, Chicago, IL (USA)); Ong, E.T.; Petri, R.J.; Remick, R.J.; Biljetina, R. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-88MC25026.

(CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The primary objective of this project is to develop and demonstrate, in subscale stacks, a novel molten carbonate fuel cell (MCFC) design concept. This concept is based on an internally manifolded heat exchanger (IMHEX) cell/stack configuration. The program is structured into three main areas: System Design and Analysis, Stack Design and Development, and Stack Testing and Scale-up. Successful development and demonstration of the IMHEX concept will provide a strong alternative to externally manifolded stacks which have exhibited carbonate management problems.

**34295** (DOE/METC–89/6105, pp. 194-201) **IMHEX power plant system.** Atabay, K. (Combustion Engineering, Inc., Windsor, CT (USA)); Kantesaria, P.P.; Lawrence, B.E.; Wagner, G.A. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-88MC25026. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The objective of the project is to undertake comparative system analyses of alternate configurations and process conditions for coal gas-fueled internally manifolded (IMHEX) molten carbonate fuel cell power plants. The results of the study will identify an efficient and cost effective concept which will merit further development in preference to other competing technologies.

**34296** (DOE/METC–89/6105, pp. 202-212) **Electrode reaction mechanisms in molten carbonate fuel cells.** Selman, J.R. (Illinois Inst. of Tech., Chicago (USA)); Yeager, E.B.; Tryk, D.A. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-86MC23266. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The objectives of this project are: (1) to obtain experimental data on electrode reaction kinetics of oxygen reduction in molten carbonate at nickel oxide electrodes; (2) to construct and use rotating electrodes, of well-defined convection properties, and microelectrodes for such kinetic measurements; (3) to determine relative concentrations of complex oxygen species in molten carbonate electrolyte by spectroscopic measurements; (4) to present an interpretation of the data in terms of reaction mechanism, with application to the molten carbonate fuel cell (MCFC) cathode.

**34297** (DOE/METC–89/6105, pp. 213-218) **Effect of coal-derived trace species on the performance of molten carbonate fuel cells.** Yuh, Chaoyi (Energy Research Corp., Danbury, CT (USA)); Hon, Sowfun. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-88MC25009. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The objective of this contract is to establish tolerance levels and guidelines for modeling the effects of 10 major, minor and trace coal-gas contaminants on the performance of the Molten Carbonate Fuel Cell. The primary goal in this study will be to first assess individual effects of some newly selected species, after which the overall combined effect of a number of the coal-derived contaminants will be studied. The species will be present simultaneously at their estimated tolerant concentrations in a simulated, hot-gas-cleaned, gasifier fuel. The species to be studied will include mercury (Hg), tin (Sn), lead (Pb), selenium (Se), arsenic (As), zinc (Zn) and cadmium (Cd) in the presence of ammonia ($NH_3$), hydrogen sulfide ($H_2S$) and a halide (HCl).

**34298** (DOE/METC–89/6105, pp. 219-225) **Molten carbonate fuel cell research.** Kucera, G.H. (Argonne National Lab., IL (USA)); Smith, J.L.; Brown, A.P. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

Research at Argonne National Laboratory (ANL) on the Molten Carbonate Fuel Cell (MCFC) is directed to the development of new materials that are chemically and polymorphically stable in the cathode and/or anode environment and to the evaluation of these materials for use in cell electrodes. In addition, significant effort is focused on the development of the processes necessary for the fabrication of these materials into electrodes as well as on the investigation of fuel cell phenomena through the interpretation of cell test data and results.

**34299** (DOE/METC–89/6105, pp. 241-248) **Phosphoric acid technology status.** Breault, R.D.; Randall, S.A.; Scheffler, G.W.; Schiller, T.G. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The overall objective of the three contracts reported in this paper is to advance the phosphoric acid fuel cell technology base necessary for commercial on-site and electric utility power generators. For the On-Site Technology Development Program, the specific objectives were to: (1) develop component technologies consistent with the goals of the 200-kilowatt on-site fuel cell commercialization program, (2) scale-up components containing this new technology to the 200-kilowatt size, and (3) verify this technology developed at the 200-kilowatt size via a test article containing a fuel processor, cell stack, water coolant/treatment system, ancillaries and controls. In the Electric Utility Full-Area Scale-Up Program, the objectives were to: (1) develop the materials and processing technology necessary to fabricate 10 sq. ft. Configuration A components, (2) run a series of short stacks to evaluate this technology and (3) verify the technology in a full-area, full-height (462-cell) cell stack. Finally, the objectives for the Electric Utility Configuration B Program are to: (1) adapt and develop the technology of the Configuration B design for electric utility applications and (2) verify this technology through a series of short stack tests.

**34300** (DOE/METC–89/6105, pp. 249-258) **Improved anode catalysts for coal gas-fueled phosphoric acid fuel cells.** Kosek, J.A. (Giner, Inc., Waltham, MA (USA)); Kackley, N.D. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-88MC25170. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The overall objective of this program is to develop, optimize and demonstrate contaminant-tolerant anode catalysts for phosphoric acid fuel cells. The goal is to develop supported catalyst systems for $H_2$ oxidation that are able to operate on coal-gas derived fuels containing high levels of CO, $H_2S$ and COS. The ability of these catalysts to boost the power content of the fuel gas by releasing additional $H_2$ via the shift reaction or anodic oxidation of CO to $CO_2$ will also be determined and optimized. The development of contaminant-tolerant anode catalysts for the PAFC will allow less stringent specifications for gas clean-up apparatus in a combined coal gasification/fuel cell power plant. This will reduce overall capital costs of the power plant and make the PAFC a more attractive alternative power source.

**34301** (DOE/METC–89/6105, pp. 259-269) **Operation of phosphoric acid fuel cells on coal gases.** Jalan, V. (ElectroChem, Inc., Woburn, MA (USA)); Poirier, J.; Desai, M.; Morriseau, B. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC02-87ER80493. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The objective of this program is to develop anode elctrocatalysts for the phosphoric acid fuel cell (PAFC) that will operate with low polarization on coal derived fuel gases containing significant

amounts of carbon monoxide and hydrogen sulfide. Several approaches will be explored to improve anode performance. The Pt electrocatalyst will be finely dispersed on ultra-high-surface-area carbon blacks to maximize the area of active reaction sites. Also, Pt, which is one of the most active electrocatalysts for anode gases but which is quickly poisoned by adsorption of CO and $H_2S$, will be alloyed with other metals to maximize performance levels by minimizing adsorption of CO and $H_2S$. Finally, operating temperatures will be adjusted to maximize anode performance and operating life.

34302 (DOE/METC–89/6105, pp. 270-275) **Improved electrolytes for fuel cells, Part A.** Gard, G.L. (Portland State Univ., OR (USA)). USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract FG21-88MC25142. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

To design, synthesize, and characterize new and known fluorosulfonic acids/salts for use as fuel cell electrolytes. This objective also encompasses development of preparative routes to new and known sulfonic acids/salts and to synthesize sulfonic acids in amounts needed for testing. To carry out a planned structural study of fluorosulfonic acids that will evaluate factors such as stability, acidity, surface activity, oxygen solubility, conductivity, and overall fuel cell performance brought about by (i) substituent/terminal grouping, (ii) chain-length and (iii) heteroatoms in the chain. All factors will be correlated with, and related to, the overall increased efficiency for fuel cell electrolytes. To carry out studies involving synergistic effects of fluorosulfonic acids with phosphoric acid systems.

34303 (DOE/METC–89/6105, pp. 276-283) **Improved electrolytes for fuel cells, Part B.** Roe, D.K. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract FG21-88MC25142. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

Objectives are as follows: (1) establish a protocol for the evaluation of the electrochemical behavior of newly synthesized fluorosulfonic acids; (2) in conjunction with Dr. Gard's group, evaluate the acids at each step in their purification using a thin solution layer cell to minimize the required sample size; (3) determine the characteristics of the reduction of oxygen in solutions of these acids and as additives to phosphoric acid; (4) evaluate the reduction of oxygen in these acids over a wide temperature range using a ring-disk electrode made from platinum evaporated on a ceramic base and with currently available gas diffusion electrodes; and (5) identify the presence of surface active compounds with Fourier transform infrared spectroscopy (FTIR) and IR reflectance absorbance spectroscopy (IRRAS).

34304 (DOE/METC–89/6105, pp. 287-296) **Westinghouse air cooled PAFC status, accomplishments and issues.** Wright, M.K. (Westinghouse Electric Corp., Large, PA (USA)); France, L.L.; Kelly, J.L.; Pereira, A.J.; Kush, A.K. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC21-82MC24223. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

The DOE-METC sponsored Technology Development Program consists of four logical units of work. These work elements are planned to reflect progressive stages of technology achievement via the demonstration of subscale cells and ten cell, 32 kW, and 100 kW stacks and the end product or the 375 kW module. The overall program consists of four primary work elements. These are fuel cell development and test, system engineering, facilities development and program management. Each of these top level work elements involves two or more subtasks depending upon the technology maturity. Three of the four planned logical units of work are complete with the fourth initiated in late 1987.

34305 (DOE/METC–89/6105, pp. 297-315) **Application of fuel cell technology to energy savings in the chlor-alkali industry.** Taylor, E.J. (PSI Technology Co., Andover, MA (USA)); Vilambi, N.R.K. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. DOE Contract AC02-86ER80366. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

Brief description of the individual fuel cell derived technologies and the status of the electrocatalyst/electrode development efforts for each of these technologies is presented in this paper. Further, results of a differential net present value economic analysis conducted for each of these technologies is presented and discussed. All the fuel cell technologies investigated exhibit potential for significant energy savings in the chlor-alkali industry. Economic analysis indicates that the commercial attractiveness for the above technologies is in the order: CAC + HCIFC > CAC + ECC + AFC > CAC + ECC > CAC + AFC > ADCAC. Increasing the lifetime of the fuel cell electrodes and minimizing the cost of the fuel cell modules appear to be the major challenges impending the speedy implementation of the fuel cell technologies in the chlor-alkali industry.

34306 (DOE/METC–89/6105, pp. 316-327) **Perfluorosulfonic acid polymer films in phosphoric acid fuel cells.** Martin, C.R.; Lawson, D.R. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

Fuel cells convert chemical energy into electrical energy via a reaction in a cell where transferred electrons can be harvested and used for power. Current generation $H_2/O_2$ fuel cells use phosphoric acid as electrolyte due to its low cost, stability at high temperatures, low vapor pressure and high conductivity. However, the rate of oxygen reduction on platinum cathodes in concentrated phosphoric acid is slow compared with aqueous solutions of strong acids (Appleby 78). This is a result of decreased $O_2$ solubility, slow $O_2$ diffusion, low $H^+$ activity and anionic adsorption in 85% $H_3PO_4$ (Hsueh 84). Decreased efficiencies for phosphoric acid fuel cells are attributed to slow oxygen reduction and associated cathodic polarization losses. The authors are conducting research in this area, primarily investigating kinetic effects on the oxygen reduction reaction in phosphoric acid at perfluorosulfonate ionomer film-coated Pt. Perfluorosulfonate ionomers (PFSI's) should overcome many of the problems associated with oxygen reduction at bare Pt in $H_3PO_4$. In the acid form, PFSI films behave as super-strong acids. Oxygen is very soluble in the PFSI fluorocarbon backbone. In addition, fixed anionic sites in the PFSI film reject anionic transport at the concentrations of $H_2PO_4^-$ found in 85% $H_3PO_4$. This should improve reduction kinetics at film-coated versus bare Pt in $H_3PO_4$. Thus, the authors are characterizing oxygen reduction kinetics and oxygen solubility and diffusion for a number of PFSI's. These studies will determine the film properties that are most important in the oxygen reduction reaction. Following this determination, they will apply these findings under fuel cell conditions. Measurements under fuel cell conditions should clarify the effect of the enhanced reaction rates on the efficiencies in a working phosphoric acid fuel cell.

34307 (DOE/METC–89/6105, pp. 328-336) **Evaluation of highly dispersed platinum catalysts for fuel cells.** Scherson, D.A. (Case Western Research Univ., Cleveland, OH (USA)). USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

This work is aimed at examining the spectroscopic and electrochemical properties of sub-, mono- and multilayer Pt deposits on carefully selected carbon supports, so as to gain a fundamental understanding of particle size effects and metal-substrate interactions in electrocatalytic systems with direct relevance to energy conversion and energy storage.

# 32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

## 3201 Buildings

*Refer also to citation(s) 33670, 33675, 33866, 33873, 34221, 34244, 34249, 34368, 34399, 35018, 35077*

**34308** (AUC-IBT-R–8903) **Simulation of temperature sequences in an outer brick wall (BST-model).** Evensen, L. Aalborg Universitetscenter (Denmark). Inst. for Bygningsteknik. Feb 1989. 41p. (In Danish). Order Number DE92703889. Source: OSTI; NTIS (US Sales Only).

A 2-dimensional thermal simulation model (Building Structure Thermodynamics Model) for arbitrary material structures in buildings is described. The model has been tested on a traditional cavity wall of bricks and can estimate the coefficients of the thermal transition $\alpha_i$ and $\alpha_u$, and the coefficient of the thermal conduction $\lambda$ for the cavity wall material. (CLS).

**34309** (BNL–52284, pp. 5-8) **Oil heat technology for the 21st century. An overview of the BNL/DOE combustion equipment technology program.** McDonald, R.J. Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

Oil is used to heat more than 12 million homes in the US. Over 80% of those homes are located in the Northeast, North Central, and Mid-Atlantic states where colder climates and higher electricity prices prevail. Most of these are in suburban areas where access to natural gas lines is limited. These residences consume approximately two quards of oil per year at an annual cost in excess of $10 billion. The vulnerability of the oil-heat consumer to fluctuations in oil prices and availability, the lack of available alternative energy sources, the concern about acid rain in these areas, and the fragmented nature of the oil-heat industry's R and D efforts has promoted the US Department of Energy (DOE) to assist the private sector in developing a technology base from which advanced energy-efficient oil combustion systems can evolve. Since 1976, DOE's Office of Building Technologies (OBT), working through the Brookhaven National Laboratory (BNL), has concentrated efforts on upgrading the technology applied to residential and light commercial space heating systems. Researchers at BNL's Combustion Equipment Technology Laboratory (CETL), in cooperation with academic and private sector organizations, are developing and evaluating innovative systems and components. These efforts assist in the effective transfer of the technology into the marketplace. The accomplishments of the OBT/BNL program in combustion equipment technology are numerous. Their identification, characterization, and transfer of modern flame retention head burner technology is credited with projected savings of 1.7 quads of oil by the year 2000. Over the past decade, researchers at BNL have identified many energy saving space-heating retrofit options and evaluated potential benefits or deficiencies in the advanced technologies that are introduced into the marketplace.

**34310** (BNL–52284, pp. 9-22) **Field tests on advanced control strategies.** Butcher, T.A.; Wei, Gang. Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

In prior studies at BNL an evaluation was made of sensors which might be used to improve the efficiency, servicing and reliability of oil heating equipment. One approach, the use of optical flame diagnostics, appeared particularly attractive because of its potential for simplicity and low cost. Optical flame sensors could be based on either brightness (one sensor) or flame color (two or more sensors). A prototype Flame Quality Indicator (FQI) based on simple brightness has been built at BNL and is currently undergoing field evaluations. This paper describes the system and the field test program. At present seven prototype units are being field tested. Two have been isntalled in boilers in homes near BNL and five have been installed in home furnaces in Ottawa, Canada. An additional unit has been installed in a sidewall vented furnace undergoing extended tests in the BNL lab. The effort in Canada is being done under the sponsorship of Canada Mortgage and Housing Corporation. All of the other work is sponsored by the US Department of Energy. These tests were started in the middle of the 1989/1990 heating season and will continue through the next season.

**34311** (BNL–52284, pp. 23-42) **New applications for low-firing-rate oil burners.** Andrews, J.W. Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

This paper discusses an evaluation of three possible applications for low-firing-rate oil burners in residential and small commercial buildings. Low firing rate or low input is defined here as <0.5 gallon per hour input of fuel oil. The first application, called the booster boiler, involves retrofitting an existing, low-efficiency system with a small, efficient add-on boiler, which will carry most of the heating and hot water load, while the existing boiler is retained in the system as a backup. The second application is a two-stage burner that would be retrofittable into existing systems; it would be the next stage of advance over the popular flame-retention-head burner. The third application of a low-firing-rate burner is to a high-efficiency oil-fired water heater.

**34312** (BNL–52284, pp. 43-62) **Oil appliance venting technology.** Krajewski, R.F. Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

This paper summarizes the results of realistic testing of residential direct-exhaust oil-fired heating equipment at BNL. The purpose of this testing was to identify and quantify certain performance parameters associated with postpurge requirements. Direct-exhaust systems operating with postpurge periods of 1 minute were quite effective in restoring flue gas oxygen level to near that of ambient conditions. Detectable odors from combustion products and post combustion fumes were not examined. The results indicated that positive vent flows after the postpurge period were beneficial in controlling nozzle reheating but that negative vent flows resulted in severe nozzle temperature conditions. Furnace nozzle operation appeared to be more critical than that of a wet base boiler. Flue gas temperature distribution within the flue piping over the heating off-cycle suggested that complex flows exist and that flue connector piping may be an active participant in reducing off-cycle flows and consequent losses in direct-exhaust applications. The initial comparisons between direct vent off-cycle sensible and infiltration induced losses calculated from test data and those calculated for comparable chimney losses using the AFUE procedure reveal no distinct advantage for one system over the other at this time.

**34313** (BNL–52284, pp. 63-76) **New Swiss developments in low emission oil and gas firing technology.** Fullemann, J. Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

The paper describes the features of a new range of oil burners characterized by high combustion efficiency and extremely low flue gas emissions. This is achieved by a technique of pre-gasification using recirculated combustion gases. By adopting a rotary system for the domestic burner, problems of nozzle blockage have been avoided, making it possible to reduce the lower end of the rating range to 6 kW (20,500 Btu/h). The technique of pre-gasification is also used for the pressure-jet burner, giving a range of 25 kW to 1MW (85,300 Btu/h to 3.42 MBtu/h). Start-up emissions in both types of burner have been minimized through the use of electric pre-heaters. A parallel development, also described in this paper,

is the twin-shell boiler in which heat is transferred from the combustion chamber to a low water capacity inner shell which is connected by a recirculating pump to the larger capacity outer shell. The low thermal inertia of the inner shell gives rapid temperature pickup (70 seconds) from a cold start, reducing the risk of acid condensation. Helical strakes within the inner shell accelerate the gas stream, increasing heat transfer rate and attenuating combustion noise at the flue.

**34314** (BNL–52284, pp. 167-175) **Sandwiched heating surfaces on the example of the hot water heating boiler manufactured by Viessmann Manufacturing Company Inc., Model Vitola-Biferral.** Prell, H. (Viessmann Manufacturing Co., Inc., Waterloo, Ontario (Canada)). Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

This paper discusses the design of a residential/commercial hot water heating boiler of composite steels/cast iron. It is designed to overcome fuel and flue gas condensation problems as well as gain high efficiency and low emmissions. Historical aspects of boiler design are addressed as well.

**34315** (BNL–52284, pp. 177-188) **The Titan Lomas boiler: A new approach.** Fisher, L.A. Brookhaven National Lab., Upton, NY (United States). Nov 1990. (CONF-9005350–: 1990 oil heat technology conference and workshop, Upton, NY (United States), 21-22 May 1990). In *Proceedings of the 1990 oil heat technology conference and workshop.* 235p. Order Number DE91012127. Source: OSTI; NTIS.

Conventional wet base cast iron sectional and steel dry base water boilers with tankless heaters have dominated the US market for decades. Although improvements in heat transfer (UA) and in off-cycle convection losses have provided higher AFUE performance, there are several important areas not defined in AFUE that need to be addressed in order to provide the homeowner with more value in quality heating, home comfort, reliability, and fuel consumption. These areas include the following: (1) reduce the jacket loss; (2) reduce degradation (fouling) of heating surfaces; (3) improve the ease of cleaning heating surfaces; (4) reduce or attenuate combustion noise; (5) reduce the heating capacity to match the heating load; (6) reduce the boiler mass for quicker on-demand warmup and quicker cool down or pump-down; (7) improve the gas distribution through the parallel flues for more effective heat transfer. Although items 5 and 6 would render the tankless heater nearly useless the Titan™ Lomas Boiler with its companion Aqua Mite™ water heater addresses all seven of the added values listed. This paper describes some of the technical aspects of this efficient, quiet, easy to clean, oil fired, low mass, corrosion resistant, vertically down-fired, forced hot water heating boiler. When coupled to the well insulated storage type water heater the boiler's mass (capacitance) and low standby loss become critical and must be minimized in order to provide a high EF (Energy Factor) water heater performance as well as a high AFUE performance.

**34316** (CONF-911242–1) **Energy efficient buildings: A world of possibilities.** Kuliasha, M.A. Oak Ridge National Lab., TN (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From POLYMET '91 conference and exhibition; Hong Kong (Hong Kong); 9-13 Dec 1991. Order Number DE91016777. Source: OSTI; NTIS; GPO Dep.

Throughout the world, buildings are a major energy consumer. However, it can be shown that buildings that save from 30 to 50% over common practice can be built using available technologies while actually increasing occupant comfort and functionality. In addition, many technologies are in the development stage that promise even further increases in energy efficiency in buildings. This paper reviews the current state-of-the-art in energy efficient building practice including building equipment and envelopes. Topics discussed include heating, ventilating and air conditioning equipment; lighting; insulation; building envelopes; and building commissioning. The energy effects of switching to non-chlorofluorocarbons in building insulation and refrigeration equipment are discussed. Advanced technologies currently under development that might have a substantial impact on future energy use including advanced absorption chillers, new lighting and window technologies, and thermally activated heat pumps are also described. 24 refs., 6 figs.

**34317** (DOE/RL/11746–T2) **Innovative retrofit concepts for saving energy in existing buildings.** Gerritsen, H. Advanced Environmental Research Group, Inc., Woolwich, ME (United States). 20 Aug 1989. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-89RL11746. Order Number DE91018940. Source: OSTI; NTIS; GPO Dep.

The concept to be examined for feasibility involves the use of holographic diffractive structures (HDSs) to collect and redirect sunlight from the whole range of solar angles as they vary with the hour of the day and the seasons of the year. These HDS collectors can be used on any building surface to project sunlight into interior spaces which have no direct access to natural light. Spaces such as plenums which exist for the accommodation of HVAC equipment or air shafts could serve as hollow light guides through which the sunlight is projected. The sunlight will be reflected by baffles at the receiving end to serve as a useful source of illumination which can replace electric light whenever the sun is shining. Substituting sunlight for electric light will save energy for both lighting and cooling, particularly during summer peak-loading conditions, while at the same time improving the quality of illumination within the space. It is anticipated that the HDSs will provide a relatively inexpensive alternative to mechanical sun-tracking devices. 6 refs., 3 figs.

**34318** (ENET–8900168/5) **Solar housing in use: Survey on experimental installation in three large blocks of flats.** Galland, B. (Ecole Polytechnique Federale, Dep. d'Architecture, Lausanne (CH)); Galley, F.; Amphoux, P. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Feb 1990. 167p. (In French). Order Number DE92714220. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

This report describes a sociological investigation carried out by the Institut de Recherche sur l'Environnement Construit (IREC) at the request of the Laboratoire d'Energie Solaire (LESO) of the EPFL. It concerns the solar energy multi-family housing estate in Preverenges. It deals with the history of this project and reports on an investigation concerning the inhabitants. figs., refs.

**34319** (ENET–8900424/1) **Long distance energy supply with heat pumps. Short report: Guide to practical realisation.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1987. 17p. (In German). Order Number DE92714228. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

This report summarizes a report which describes the procedure of a heat pump project. It shows the practical realization of heat pump installations for the exploitation of ground and surface water. This should facilitate a simple and speedy development of such a project. The guide deals with the legal, administrative and technical aspects.

**34320** (ENET–8900424/2) **Thermal balance of groundwater Hasle-Burgdorf. Short report: Period of investigation 1986-1987.** Bigler, R.; Christen, J.; Geiger, T.; Hunziker, R.; Muchenberger, F.; Mueller, H.; Werner, A.; Wuersten, M. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Jul 1989. 82p. (In German). Order Number DE92714227. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

This study was carried out to assess the potential temperature in the groundwater available for the use in heat pumps. After recording the hydrological basic data of the test area, a thermal balance was generated and a model of the heat transport developed. This enabled the usable heat in the test area to be assessed. figs., 35 refs.

**34321** (ETDE/JP-mf–2709542) **Structural behavirour and design of truss structures stabilized by cable tension.** Hangai, Y. (The University of Tokyo, Tokyo (Japan). The Institute of Industrial Science); Kawaguchi, K.; Oda, K. Tokyo Univ. (Japan). Inst. of Industrial Science. May 1991 30p. (In Japanese). Order Number DE92709542. Source: OSTI; NTIS (US Sales Only).

Tension-stabilized truss structures composed of stabilized unit structures were proposed, and their structural behavior were studied by theoretical analysis and in experiments. As the analytical theory of unstable structures, based on a conditional expression of compatibility or equilibrium expression, some equations were derived for calculating a rigid body displacement system and self-equilibrated stress system, and for composing geometric stiffness by introduction of initial stress. Geometrically nonlinear equations were also derived considering slackening of cables. The stabilized unit structure was provided by introducing initial stress by a post and cables into an unstable truss structure composed of four truss members connected with each other through frictionless pin-joints, and the correlation between structural parameters and behavior was evaluated with six selected parameters. The behavior of the truss structure composed of above unit structures was analyzed theoretically, resulting in its applicability to roof structures. 27 refs., 59 figs., 9 tabs.

**34322** (KTM/E-B–91) **LVIS-2000 Future building services: Interim report 1988-1990.** Kohonen, R. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). LVI-tekniikan Laboratorio). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 92p. Project KTM-305/881/87. Order Number DE92703967. Source: OSTI; NTIS (US Sales Only).

Finland's energy research programmes.

A common system theory of building service systems has been introduced, according to which a system consists of a room device, distribution network, energy poduction and storage modules and of a control and man-machine interface. Furthermore, each system development project has adopted a concept of a complete functioning entity and the compatibility with industrial construction process. New aspects besides rational and efficient use of energy are operational reliability and availability and environmental pollution. In the studies supporting the development of HVAC-, electricity and BEMC-systems the criteria for ventilation rates, thermal control controllability and reliability of HVAC-systems have been specified. An open question is still the relation of the indoor climate and work productivity. New concepts for residential ventilation systems, cooling of buildings, electrical installation atd BEM-systems have already been introduced. In the course of three fiscal years of the LVIS-2000 research programme ahout ten application projets have been initiated by industry and end-users. Collaboration and information transfer between research institutes and industry and other end-users as well have also progress positively. The active participation of about SW people to the seminars organized by the programme indicate the same. Also interest of enterprises in the demonstration projects has increased. Severe new products have been introduced into the market as well.

**34323** (KTM/E-B–93) **ETRR Energy-efficient buildings and building components: Interim report 1988-1990.** Saarimaa, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Rakennusmateriaalilab.). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 96p. Project KTM-300/881/87. Order Number DE92704053. Source: OSTI; NTIS (US Sales Only).

Finland's energy research programmes. Published also in Finnish Report no B:92.

The state of art report comprises a summary of the most central results of the research during 1988 - 1990. The ETRR research programme seeks to study a variety of building envelopes and structures which can improve energy efficiency as well as comfort. The focus is in the other hand on the whole building and on the other hand on the components of the building envelope. The energy saving measures in buildings have been studied in low energy building concept projects. They have considered technical solution for energy savings in both low and high rise buildings. New buildings as well as retrofitting of existing buildings have been studied. On the building component level the main emphasis has been on new technologies such as new window technology and use of structures based on transparent insulations. The programme has also improved calculation methods for energy analysis of building as well as for analysis of hygrothermal behaviour of building components. The industrial joint development projects analyze the performance of new measures by experimental building.

**34324** (LBL–24870) **The Phase 3—Efficient lighting for US Naval ships: Interim report.** Verderber, R.R. Lawrence Berkeley Lab., CA (United States). 21 Jan 1988. 19p. Sponsored by USDOE, Washington, DC (United States); David Taylor Research Center, Bethesda, MD (United States). DOE Contract AC03-76SF00098. Order Number DE92000692. Source: OSTI; NTIS; GPO Dep.

The first two phases of this program developed a lighting system that improved the system efficacy from 46 lm/w to 58 lm/w. In addition, the a power factor of 90% was attained which reduced the supply current by 46% as well as reducing the harmonic content below 3%. This system is being demonstrated on board a ship for final acceptance, and is expected to be employed on newly constructed ships. Phase 3 of this program explores the development of a still more efficient lighting system, in which an efficacy of 80 lm/w is the target. The system is a centralized system in which the 115 volt a.c. is distributed to one or more site on board ship and converted to a d.c. voltage. The d.c. is distributed on to a large group of lamps. At each lamp there will be an oscillator that converts the d.c. to a high frequency a.c. voltage that drives the lamp. This report is an analysis of the rectifying circuit, its efficiency and an estimated cost. 1 fig., 5 tabs.

**34325** (LBL–28147-Vol.1) **Measured energy savings and economics of retrofitting existing single-family homes: An update of the BECA-B database: Volume 1.** Cohen, S.D.; Goldman, C.A.; Harris, J.P. Lawrence Berkeley Lab., CA (United States). Feb 1991. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000689. Source: OSTI; NTIS; GPO Dep.

The energy bill for US single-family households was over $77 billion in 1987 (excluding auto fuel purchases), accounting for approximately 20% of national energy expenditures. Large sums are spent on residential retrofits by individual homeowners, government agencies, and utilities. As of late 1987, over 21 million households indicated that they had added at least one energy-saving measure in the previous two years, while a recent Electric Power Research Institute (EPRI) study estimated that nearly 15 million residential customers have participated in some kind of demand-side management (DSM) program. Given the level of continuing investments in residential energy efficiency, accurate estimates of savings from various conservation measures are increasingly necessary, especially as new technologies become more sophisticated and incremental efficiency gains more difficult to achieve. This report provides a comparative analysis of measured data on the performance and cost-effectiveness of energy-saving measures in existing single-family homes, based on information in the Buildings Energy-Use Compilation and Analysis (BECA) data base. The initial BECA report on measured data for single-family retrofits was completed seven years ago. In updating the single-family database, we have added 135 data points, representing over 33,000 houses, to the original database of 145 retrofit projects. The report is organized in two volumes. Volume 1 provides a summary of energy savings and costs of individual retrofit measures and strategies and results from federal/state low-income and utility weatherization programs. we also discuss measurement issues, predicted versus actual savings, trends in single-family retrofit programs, and implications for the "next generation" of cost-effective single-family retrofits. Volume 2 contains a written summary of each retrofit project and complete data tables. 87 refs., 20 figs., 16 tabs.

**34326** (LBL–28147-Vol.2) **Measured energy savings and economics of retrofitting existing single- family homes: An update of the BECA-B database: Volume 2.** Cohen, S.D.; Goldman, C.A.; Harris, J.P. Lawrence Berkeley Lab., CA (United States). Feb 1991. 76p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000690. Source: OSTI; NTIS; GPO Dep.

These appendices are the companion volume to report number LBL–28147 Vol.1, with the same title. The summary data tables include physical characteristics, energy consumption, savings, and the retrofit measures installed and their costs for each retrofit project. Each "existing single family residential building" retrofit project in the BECA-B database is described. 99 refs. (BM)

**34327** (LBL–28793) **Automatic lighting controls demonstration: Final report.** Rubinstein, F.; Verderber, R. Lawrence

Berkeley Lab., CA (United States). Mar 1990. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000688. Source: OSTI; NTIS; GPO Dep.

For Pacific Gas and Electric Co., San Ramon, CA.

The purpose of this work was to demonstrate, in a real building situation, the energy and peak demand reduction capabilities of an electronically ballasted lighting control system that can utilize all types of control strategies to efficiently manage lighting. The project has demonstrated that a state-of-the-art electronically ballasted dimmable lighting system can reduce energy and lighting demand by as least 50% using various combinations of control strategies. By reducing light levels over circulation areas (tuning) and reducing after hours light levels to accommodate the less stringent lighting demands of the cleaning crew (scheduling), lighting energy consumption on weekdays was reduced an average of 54% relative to the initial condition. 10 refs., 14 figs., 3 tabs.

**34328** (LBL–29798) **481 Prototypical commercial buildings for 20 urban market areas: Technical documentation of building loads data base developed for the GRI cogeneration market assessment model.** Huang, J.; Akbari, H.; Rainer, L.; Ritschard, R. Lawrence Berkeley Lab., CA (United States); Gas Research Inst., Chicago, IL (United States). Apr 1991. 202p. Sponsored by USDOE, Washington, DC (United States); Gas Research Inst., Chicago, IL (United States). DOE Contract AC03-76SF00098. (GRI–90/0326). Order Number DE92000754. Source: OSTI; NTIS; GPO Dep.

This report documents the methodology used to determine the load patterns and estimate the building populations for various commercial and multi-family buildings in 20 representative markets of the US. The task involved describing nearly 500 prototypical buildings by building type, vintage, and city, defining their internal conditions and operating schedules, and then simulating their hourly energy profiles using the DOE-2.1D building energy simulation program. The simulated energy usages were than calibrated against statistical data and the building descriptions modified to better correlate to measured energy and end-use intensities and fuel/electric ratios. A secondary task involved using statistical data on construction activity and surveys to estimate the numbers and total floor areas represented by each of the prototypical buildings. The primary objective of this project is to supply input information on building loads and market sizes for a microcomputer program. The purpose of this program, here referred to as the Commercial Cogeneration Assessment Model (CCAM), is to assess the potential of cogeneration in commercial and multi-family buildings from the present to the year 2000. A secondary objective for this project is to provide a large data base of hourly load profiles for prototypical commercial buildings that can be used for other technical studies. Detailed descriptions of the data output are given. 50 refs., 5 figs., 126 tabs.

**34329** (LBL–29851) **The California Healthy Building Pilot Study: I. Study design and protocol.** Daisey, J.M. (Lawrence Berkeley Lab., CA (United States)); Fisk, W.J.; Hodgson, A.T.; Mendell, M.J.; Faulkner, D.; Nematollahi, M.; Macher, J.M. Lawrence Berkeley Lab., CA (United States). Dec 1990. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000658. Source: OSTI; NTIS; GPO Dep.

The California Healthy Building Pilot Study was conducted in 12 office buildings in two climate zones in the San Francisco Bay area, was designed to test several hypotheses concerning the relationships between type of building ventilation, air quality, thermal comfort and occupant symptoms. The primary objectives of the study were (1) to determine the prevalence of various occupant symptoms and perceptions of thermal comfort in office buildings; (2) to determine if there is a difference in occupants' symptom prevalence between buildings with natural ventilation and those with mechanical ventilation, both with and without air conditioning; (3) to examine the relationships between symptoms and measured characteristics of the indoor environment; and (4) to develop and field test new techniques for characterizing building ventilation and indoor air quality. This pilot study included explicit testing of prestated hypotheses, selection of public office buildings based on ventilation type, without regard to worker complaints, use of a questionnaire based on work-related symptoms keyed to the time and location of environmental measurements, and the development and testing of new methods for characterizing ventilation effectiveness by means of a Pollutant Control Index and volatile organic compounds by means of an irritancy index. In addition, the questionnaire included measures by "environmental worry" to allow adjustment for biased symptom reporting among those worried about adverse health effects of their indoor environment, and a previously validated scale of job stress/satisfaction to allow control for biased symptom reporting among those dissatisfied with their jobs. 34 refs., 2 tabs.

**34330** (LBL–30041) **Alternatives to compressor cooling in California climates: Review and outlook.** Feustel, H. (Lawrence Berkeley Lab., CA (United States)); de Almeida, A.; Blumstein, C. Lawrence Berkeley Lab., CA (United States). Jan 1991. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000707. Source: OSTI; NTIS; GPO Dep.

This review and discussion has been prepared for the California Institute for Energy Efficiency (CIEE) to examine research on alternatives to compressor cooling. The report focuses on strategies for eliminating compressors in California's transition climates – moderately warm areas located between the cool coastal regions and the hot central regions. Many of these strategies could also help reduce compressor use in hotter climates. Compressor-driven cooling of residences in California's transition climate regions is an undesirable load for California's electric utilities because load factor is poor and usage is typically high during periods of system peak demand. We review a number of alternatives to compressors, including low-energy strategies: evaporative cooling, natural and induced ventilation, reflective coatings, shading with vegetation and improved glazing, thermal storage, and radiative cooling. Also included are two energy-intensive strategies: absorption cooling and desiccant cooling. Our literature survey leads us to conclude that many of these strategies, used either singly or in combination, are technically and economically feasible alternatives to compressor-driven cooling. 78 refs., 8 figs.

**34331** (LBL–30401-Pt.1) **Integrated estimation of commercial sector end-use load shapes and energy use intensities: Phase 2, Part 1: Final report.** Akbari, H.; Rainer, L.; Eto, J. Lawrence Berkeley Lab., CA (United States). Jan 1991. 118p. Sponsored by USDOE, Washington, DC (United States); California Inst. for Energy Efficiency, CA (United States). DOE Contract AC03-76SF00098. Order Number DE92000668. Source: OSTI; NTIS; GPO Dep.

In this study, sponsored by the California Energy Commission (CEC), we used a new end-use load shape estimation technique to develop a database of commercial sector end-use load shapes and energy-use intensities (EUIs) for the CEC's commercial energy and peak load forecasting models. The technique relied on a reconciliation of whole-building hourly electricity load data to energy simulations developed from an analysis of survey data. The technique was applied to four building types (schools, colleges, health, and lodging) and resulted in reconciled hourly electricity load shapes for eight end uses. The end uses included cooling, ventilation, lighting, cooking, refrigeration, water heating, hospital equipment, and miscellaneous equipment. Ventilation and cooling load shapes were estimated separately for four climate regions in southern California. The load shapes were aggregated to produce annual end-use EUIs, and twelve monthly end-use load shapes for three day types (peak, standard, and non-standard). The end-use EUIs were then adjusted to account for observed end-use saturations in the population, the effects of price and technological change, and, most importantly, the impacts of the first generation of California building and appliance standards. 9 refs., 46 figs., 60 tabs.

**34332** (LBL–30401-Pt.2) **Integrated estimation of commercial sector end-use load shapes and energy use intensities, Phase 2: Final report, Appendices.** Akbari, H.; Rainer, L.; Eto, J. Lawrence Berkeley Lab., CA (United States). Jan 1991. 104p. Sponsored by USDOE, Washington, DC (United States); California Inst. for Energy Efficiency, CA (United States). DOE Contract

AC03-76SF00098. Order Number DE92000722. Source: OSTI; NTIS; GPO Dep.

This report is comprised of the appendices for report number LBL– 30401 Part 1 of 2 by the same name. One appendix includes a memorandum with detailed data of end use EUIs and load shapes for small and large office buildings and small and large retail buildings. It includes replacement tables for LBL–27512. Other appendices are the DOE-Z BDL prototype input files, summarizes of LRD, figures and results of load-temperature regressions, and THI matrices for cooling. (BM)

**34333** (LBL–30477) **The potential for electricity efficiency improvements in the US Residential Sector.** Koomey, J.G.; Atkinson, C.; Meier, A.; McMahon, J.E.; Boghosian, S.; Atkinson, B.; Turiel, I.; Levine, M.D.; Nordman, B.; Chan, P. Lawrence Berkeley Lab., CA (United States). Jul 1991. 244p. Sponsored by Environmental Protection Agency, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000727. Source: OSTI; NTIS; GPO Dep.

This study represents the most elaborate assessment to date of US residential sector electricity improvements. Previous analyses have estimated the conservation potential for other countries, states, or individual utility service territories. As concern over greenhouse gas emissions has increased, interest has grown in estimates of conservation potential for the US residential sector as a whole. The earliest detailed estimate of US conservation potential is now out of date, while more recent estimates are less detailed than is desirable for engineering-economic estimates of the costs of reducing carbon emissions. In this paper, we first describe the methodology for creating supply curves of conserved energy, and then illustrate the subtleties of assessing the technical conservation potential. Next we present the data and forecasts used in this assessment, including costs, baseline thermal characteristics, energy use, and energy savings. Finally, we present the main results and conclusions from the analysis, and discuss future work. 102 refs., 7 figs., 16 tabs.

**34334** (LBL–30498) **Design options for low-conductivity window frames.** Byars, N.; Arasteh, D. Lawrence Berkeley Lab., CA (United States). Oct 1990. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;AI79-86BP63401. Order Number DE92000715. Source: OSTI; NTIS; GPO Dep.

The window industry's commercialization of low-emissivity coatings and low-conductivity gas-filling over the past few years has helped to drastically reduce heat transfer rates through the glazed areas of windows. However, few changes have taken place in the design and construction of window frames and edges, leaving these elements to account for most of the heat transfer through today's state-of-the-art windows. This paper presents design and material requirements for the manufacture of low-conductivity window frames obtained through the use of finite element computer modeling. Such frames will compliment and not degrade today's most energy-efficient insulated glass units. 7 refs., 2 figs., 5 tabs.

**34335** (LBL–30574) **Air movement, comfort and ventilation in workstations.** Bauman, F.S. (California Univ., Berkeley, CA (United States). Center for Environmental Design Research); Arens, E.A.; Johnston, L.P.; Zhang, H.; Fisk, W.J.; McNeel, P.J.; Pih, D. Lawrence Berkeley Lab., CA (United States). Apr 1991. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000667. Source: OSTI; NTIS; GPO Dep.

This report presents findings from a research project to investigate the effects of office partition design on air movement, worker comfort, and ventilation in workstations. The objectives of the study were to evaluate the comfort and ventilation conditions produced by a conventional ceiling supply-and-return air distribution system in workstations separated by (1) solid partitions of different height (75 in. [1.9 m], 65 in. [1.65 m], 42 in. [1.1 m], and 0 in. [partitions removed]), and (2) prototype Steelcase "airflow" partitions, containing a gap positioned at the bottom of the partition. The project consisted primarily of experiments performed in a full-scale Controlled Environment Chamber (CEC) located in the Building Science Laboratory, Department of Architecture, University of California, Berkeley. 25 refs., 28 figs., 9 tabs.

**34336** (LBL–30775) **Energy conservation potentials in the Omar Effendi department store in Nasr City, Cairo, Egypt: An energy audit and analysis of end-use data: Final report.** Akbari, H.; Greenberg, S.; Kromer, S. Lawrence Berkeley Lab., CA (United States). Apr 1991. 29p. Sponsored by USDOE, Washington, DC (United States); Agency for International Development, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000666. Source: OSTI; NTIS; GPO Dep.

This report summarizes an effort to measure electricity consumption by end use in a government-owned Omar Effendi chain department store in Egypt. The monitored data are used to estimate electricity conservation potential in the building. The major end uses in this building are lighting, ventilation, and air conditioning. The building peak usage is about 60 W/m$^2$ of power for lighting and 63 W/m$^2$ for ventilation and air conditioning. It is possible to save 50% of electricity use through improvements in the efficiency of lighting and air conditioning systems. 3 refs., 9 figs., 11 tabs.

**34337** (LBL–30908) **Assessment of indoor concentrations, indoor sources and source emissions of selected volatile organic compounds.** Hodgson, A.T.; Wooley, J.D. Lawrence Berkeley Lab., CA (United States). Jun 1991. 179p. Sponsored by USDOE, Washington, DC (United States); California State Government, Sacramento, CA (United States). DOE Contract AC03-76SF00098. Order Number DE92000665. Source: OSTI; NTIS; GPO Dep.

The California Air Resources Board (CARB) is required to consider indoor exposures in assessing the risks to public health posed by compounds being reviewed for classification as toxic air contaminants. This literature review was performed to evaluate the existing data on the potential indoor uses and sources, the indoor concentrations and exposures, and the source emissions of candidate compounds not yet in the formal review process. The study was primarily restricted to organic compounds in Groups 2B and 3 of the "Toxic Air Contaminant Identification List, February, 1990." Data for 47 individual compounds were reviewed. The body of this report contains a section for each compound or group of closely related compounds in which the data from the literature are summarized and evaluated. 297 refs., 51 figs.

**34338** (ORNL/CON–262) **Thermal model of attic systems with radiant barriers: Existing buildings research program.** Wilkes, K.E. Oak Ridge National Lab., TN (United States). Jul 1991. 169p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000381. Source: OSTI; NTIS; GPO Dep.

For Tennessee Valley Authority.

This report summarizes the first phase of a project to model the thermal performance of radiant barriers. The objective of this phase of the project was to develop a refined model for the thermal performance of residential house attics, with and without radiant barriers, and to verify the model by comparing its predictions against selected existing experimental thermal performance data. Models for the thermal performance of attics with and without radiant barriers have been developed and implemented on an IBM PC/AT computer. The validity of the models has been tested by comparing their predictions with ceiling heat fluxes measured in a number of laboratory and field experiments on attics with and without radiant barriers. Cumulative heat flows predicted by the models were usually within about 5 to 10 percent of measured values. In future phases of the project, the models for attic/radiant barrier performance will be coupled with a whole-house model and further comparisons with experimental data will be made. Following this, the models will be utilized to provide an initial assessment of the energy savings potential of radiant barriers in various configurations and under various climatic conditions. 38 refs., 14 figs., 22 tabs.

**34339** (ORNL/Sub–90-89673) **A computer model for simulation of absorption systems in flexible and modular form.** Grossman, G. (Technion-Israel Inst. of Tech., Haifa (Israel). Faculty of Mechanical Engineering); Gommed, K., Gadoth, D. Oak Ridge National Lab., TN (United States); Technion-Israel Inst. of Tech., Haifa (Israel). Faculty of Mechanical Engineering. Aug 1991. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000384. Source: OSTI; NTIS; GPO Dep.

A computer code in a flexible and modular form developed for simulation of absorption systems makes it possible to investigate various cycle configurations with different working fluids. The code is based on unit subroutines containing the governing equations for the system's components. The equations are linked by a main program according to the user's specifications to form the complete system. The equations are solved simultaneously, and fluid properties are taken from a property data base. The code is user oriented and requires a relatively simple input containing the given operating conditions and the working fluid at each state point. The user conveys to the computer an image of his or her cycle by specifying the different subunits and their interconnection. Based on this information, the program calculates (1) the temperature, flow rate, concentration, pressure, and vapor fraction at each state point in the system and (2) the heat duty at each unit, from which the coefficient of performance may be determined. The program has been used successfully to simulate a variety of single-stage, double-stage, and dual-loop heat pumps and heat transformers, with the working fluids LiBr-$H^2O$,$H_2O$-$NH_3$, LiBr/$H_2O$-$NH_3$, LiBr/$ZnBr_2$-$CH_3OH$, and more. 23 refs., 10 figs., 13 tabs.

**34340** (ORNL/TM–11668/V1) **Evaluation plan for the Weatherization Assistance Program.** Beschen, D.A. (USDOE, Washington, DC (United States)); Brown, M.A. Oak Ridge National Lab., TN (United States). Aug 1991. 56p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000380. Source: OSTI; NTIS; GPO Dep.

The most recent national evaluation of the impacts of the US Department of Energy (DOE)'s Weatherization Assistance Program (WAP) was completed in 1984 based on consumption data for households weatherized in 1981. WAP regulations and operations have changed substantially over the last decade, and new opportunities are on the horizon. DOE recognizes the need for a more current national level evaluation of the program and has developed a plan for conducting the evaluation with the support of the Oak Ridge National Laboratory (ORNL). The national WAP evaluation as currently proposed has seven major goals: (1) estimate the energy saved by the program – one, two, and three years after participation; (2) assess nonenergy impacts, such as comfort, safety, and housing affordability; (3) assess program cost effectiveness; (4) analyze factors which influence energy savings, nonenergy impacts, and cost effectiveness; (5) describe the WAP network's capabilities and the innovative weatherization technologies and procedures it has employed; (6) characterize the WAP-eligible population and the federal and non-federal funds that haven been used to meet its weatherization needs; and, (7) identify promising WAP opportunities for the future. The data collection, analyses, and reports are to be completed in phases between 1991 and 1993. The evaluation methodologies vary by fuel type, housing type, and climate zone. The analysis of energy savings and cost effectiveness will be based primarily on weather-normalized, retrospective utility billing records (collected for pre- and postretrofit years). 12 refs., 8 figs.

**34341** (ORNL/TM–11668/V3) **Experimental plan for the Single-Family Study.** Berry, L.G.; Brown, M.A.; Wright, T.; White, D.L. Oak Ridge National Lab., TN (United States). Sep 1991. 128p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000412. Source: OSTI; NTIS; GPO Dep.

The national evaluation of the Weatherization Assistance Program (WAP) consists of five separate studies. The Single-Family Study is one of three studies that will estimate program energy savings and cost effectiveness in principal WAP submarkets. This report presents the experimental plan for the Single-Family Study, which will be implemented over the next three years (1991–1993). The Single-Family Study will directly estimate energy savings for a nationally representative sample of single-family and small multifamily homes weatherized in the 1989 program year. Savings will be estimated from gas and electric utility billing records using the Princeton Scorekeeping Method (PRISM). The study will also assess nonenergy impacts (e.g., health, comfort, safety, and housing affordability), estimate cost effectiveness, and analyze factors influencing these outcomes. For homes using fuels such as wood, coal, fuel oil, kerosene, and propane as the primary source of space conditioning, energy savings will be studied indirectly. The study will assemble a large nationally representative data base. A cluster sampling approach will be used, in which about 400 subgrantees are selected in a first stage and weatherized homes are selected in a second range. To ensure that the Single-Family Study is able to identify promising opportunities for future program development, two purposively selected groups of subgrantees will be included: (1) subgrantees that install cooling measures (such as more efficient air conditioning equipment or radiant barriers), and (2) exemplary subgrantees that use state-of-the-art technologies and service delivery procedures (such as advanced audit techniques, blower door tests, infrared scanners, extensive client education, etc.). These two groups of subgrantees will be analyzed to identify the most effective program elements in specific circumstances. 14 refs., 4 figs., 3 tabs.

**34342** (PNL–7656) **End-Use Load and Consumer Assessment Program: Analysis of residential refrigerator/freezer performance.** Ross, B.A. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018961. Source: OSTI; NTIS; GPO Dep.

The Bonneville Power Administration (Bonneville) is conducting a large end-use data acquisition program in an effort to understand how energy is utilized in buildings with permanent electric space heating equipment in the Pacific Northwest. The initial portion of effort, known as the End-Use Load and Consumer Assessment Program (ELCAP), was conducted for Bonneville by the Pacific Northwest Laboratory (PNL). The collection of detailed end-use data provided an opportunity to analyze the amount of energy consumed by both refrigerators and separate freezers units located in residential buildings. By obtaining this information, the uncertainty of long- term regional end-use forecasting can be improved and potential utility marketing programs for new appliances with a reduced overall energy demand can be identified. It was found that standby loads derived from hourly averages between 4 a.m. and 5 a.m. reflected the minimum consumption needed to maintain interior refrigerator temperatures at a steady-state condition. Next, an average 24-hour consumption that included cooling loads from door openings and cooling food items was also determined. Later, analyses were conducted to develop a model capable of predicting refrigerator standby loads and 24-hour consumption for comparison with national refrigerator label ratings. Data for 140 residential sites with a refrigeration end-use were screened to develop a sample of 119 residences with pure refrigeration for use in this analysis. To identify those refrigerators that were considered to be pure (having no other devices present on the circuit) in terms of their end-use classification, the screening procedure used a statistical clustering technique that was based on standby loads with 24-hour consumption. 5 refs., 18 figs., 4 tabs.

**34343** (PNL–7793) **Mobile Energy Laboratory energy-efficiency testing programs: Semiannual report, October 1, 1990–March 31, 1991.** Parker, G.B.; Currie, J.W. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 119p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000039. Source: OSTI; NTIS; GPO Dep.

This report summarizes energy-efficiency testing activities applying the Mobile Energy Laboratory (MEL) testing capabilities during the first and second quarters of fiscal year (FY) 1991. The MELs, developed by the US Department of Energy (DOE) Federal Energy Management Program (FEMP), are administered by Pacific Northwest Laboratory (PNL) and the Naval Energy and Environmental Support Activity (NEESA) for energy testing and energy conservation program support functions at federal facilities. The using agencies principally fund MEL applications, while DOE/FEMP funds program administration and capability enhancement activities. This report fulfills the requirements established in Section 8 of the MEL Use Plan (PNL-6861) for semiannual reporting on energy-efficiency testing activities using the MEL capabilities. The MEL Use Committee, formally established in 1989, developed the MEL Use Plan and meets semiannually to establish priorities for energy-efficient testing applications using the MEL capabilities. The MEL Use

Committee is composed of one representative each of the US Department of Energy, US Army, US Air Force, US Navy, and other federal agencies.

**34344** (PNL-SA–19657) **Environmental issues in planning building energy technologies R&D in the United States.** Farhar, B.C. (Solar Energy Research Inst., Golden, CO (United States)); Abel, F.H.; Nicholls, A.K.; Millhone, J.P. Pacific Northwest Lab., Richland, WA (United States). Aug 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830 ;AC02-83CH10093. (CONF-910809–3: International symposium on energy and environment, Espoo (Finland), 25-28 Aug 1991). Order Number DE92000392. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy's Office of Building Technologies (OBT) has begun studies on the relationship and impact of buildings energy use on the environment, particularly with respect to global climate change, acid rain, stratospheric ozone depletion, and indoor air quality. The paper presents an overview of international and US federal activity in global change to set OBT's activities in context. The paper then reviews briefly the contribution of buildings to atmospheric problems through building energy use. OBT's program primarily supports projects with indirect environmental impacts through energy efficiency (e.g., thermally activated heat pumps use natural gas instead of electricity) and the use of renewables in buildings. The paper briefly describes the OBT program and covers an inventory of projects that OBT has funded on environmental/building problems. Analyses have included three kinds of topics: (1) CFC substitutes for refrigeration equipment, (2) incorporating the cost of externalities into utility electricity generation, and (3) indoor air quality. The paper shows how environmental issues are being taken into account in planning the US R&D program in building energy technologies. 27 refs.

**34345** (TKK-KO/LVI–B28) **Ventilation and indoor climate in residences and the occurence of symptoms and environmental complaints among the occupants.** Ruotsalainen, R.; Roennberg, R.; Jaakkola, J.J.K.; Majanen, A.; Seppaenen, O. Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Heating, Ventilation and Air Conditioning. 1990. 74p. (In Finnish). Order Number DE92704038. Source: OSTI; NTIS (US Sales Only).

The study was carried out with field measurements and a questionnaire during the heating season 1988-89. 251 residences in the Helsinki-area were selected for the study. The sample consisted of both detached or semi-detached houses and blocks of flats. Three different types of ventilation systems were included. The mean ventilation rates measured during a two-week period varied remarkably from 0.1 to 1.5 ach across the sample. The average was 0.52 ach including also the ventilation caused by the airing. The differences between the ventilation systems were small. However, the ventilation rates were on average smaller in houses than in apartments. The mean air temperatures in bedrooms measured during the two-week period varied considerably (18 - 27 deg C). The dissatisfaction with the temperature was lowest, when the air temperature was approximately 21 deg C. Especially stuffyness and dryness of the bedroom air were problems in the residences. Almost half of the occupants felt the bedroom air in the mornings to be at least sometimes stuffy. 40 % of the occupants felt the bedroom air to be usually too dry. Humidifiers were used in over one third of the residences. The dissatisfaction with the humidity increased considerably, when the relative humidity was below 40 %. The occupants of the apartments reported systematically more symptoms and environmental complaints than the occupants of the houses. In the houses the symptoms and environmental complaints were more common among the occupants with natural ventilation than with balanced ventilation. In the apartments with balanced ventilation the occupants reported more symptoms and complaints than those with natural ventilation.

**34346** (TTKK-LT–65) **Simulation of thermal comfort in the office building.** Haapala, T. Tampere Univ. of Technology (Finland). Thermal Engineering. 1989. 86p. (In Finnish). Order Number DE92704036. Source: OSTI; NTIS (US Sales Only).

In this work it has been studied, how constant air flow and variable air flow air-conditioning and mechanically cooled air-conditioning systems affect on the indoor climate of the office building. TASE and HASP computer programs were used to calculate the indoor climate and the energy consumption of heating and possible cooling. The calculation is performed hour by hour to the whole year. The calculated indoor climate is changed to working efficiency and thermal comfort of an office worker. It was also studied the economics of mecanical cooling considering also the working efficieny. In the constant air flow system indoor air temperature get quite high. This causes about 75000 lost working hours in the office building of flow area of 3000 $m^2$. The salary costs of the lost working hours are much bigger than those of total costs of air conditioning system. Therefore the mechanical cooling can pay itself back in less than one year. Of course it is not quite clear, how the indoor climate affects on working efficiency in practice. In this study it has been used for estimating of this four different litterature sources, which are based on laboratory measurements.

**34347** (VTT-TIED–1200) **Energy conservation in lighting and domestic electricity consumption.** Lepistoe, A. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoe- ja Automaatiotekniikan Lab.). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1991. 56p. (In Finnish). Order Number DE92704010. Source: OSTI; NTIS (US Sales Only).

The energy conservation potential is more than 50 % in lighting. The technical potential is more than half of the total potential. The rest potential includes such matters as elimination of wasteful use of lighting and lighting habits. It could be possible to decrease the electricity consumption by 3.5 TWh which is some 6 % of the total electricity consumption and almost 3 % of primary energy needs. The conservation potential in households (electrical equipments etc.) is some 50 %. The technical potential is more than half of that. It could be possible to decrease the domestic consumption by some 3 TWh. From the energy economy point of view it seems to be economical to try to make the domestic and lighting consumption as efficient as possible. From the consumer point of view the use of most efficient equipment is not always economic enough or tempting. It is clear that all this potential will not realize in the future, but the growing rate of consumption will more or less slow down. The method used in this analysis is so called long run marginal cost method. The analysis includes the consumer, producer and energy economy point of views. There are some disadvantages in energy efficient lighting. The most important one is the mercury waste which problem has to be solved before wide use of energy efficient compact fluorescent lamps.

**34348** (VTT-TIED–1226) **Data processing system for building maintenance.** Lounela, T. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Rakennuslab.); Aengeslevae, J. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Mar 1991. 72p. (In Finnish). Order Number DE92704045. Source: OSTI; NTIS (US Sales Only).

The initial aim of the Information System for Building Maintenance project was to integrate the computer aided stage of building design into the computer system for building maintenance. Computer aided building design is represented in the research according to a product model of a building. The office building of Imatran Voima Ltd., which was completed a short time ago in Myyrmaeki, was chosen as an example case on grounds of its far-reaching use of a CAD-system in building design, its size, and equipment technique which requires a sophisticated maintenance system. The flow of information concerning building maintenance was examined by means of an activity analysis and interviews. The priority of functions was derived from the estimated cost savings. In the mapping of the building maintenance systems was found that there is not available a maintenance system, which could be developed in the project. The research produced a commercial product called 'Facility KUTI-X', which is used in industrial maintenance, and was chosen as a basis for the development work. The computer programming was carried out together with the end users of the product. In addition to the office building of Imatran Voima Ltd. also the facilities of Novera company, Servi Facility Maintenance company and at the end of the project the National Building Board in Home district, were the end users of the system. The system was programmed into the UNIFY data base by using ACCEL application development tool. The project includes also directions and a training program for the user, operational testing, and maintenance planning of the computer program.

**34349** (VTT-TUTK–727) **Supervisory control of variable air volume air conditioning system.** Heimonen, I. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). LVI-tekniikan Laboratorio); Kohonen, R.; Katajisto, K. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1991. 159p. (In Finnish). Order Number DE92704042. Source: OSTI; NTIS (US Sales Only).

The purpose of supervisory control is, on the one hand, to minimize energy consumption and, on the other, to ensure the operating requirements of local loops. Supervisory control can also be used to implement the various set value alterations necessitated by a change in the circumstances of building use for instance, a change from continuous to periodic use (night cooling, intermittent heating). It is not possible to present a general supervisory control algorithm that would be applicable to all systems. Supervisory control algorithms are system-specific. The operation of variable airflow rate air conditioning systems under different supervisory control algorithms in an office building and a commercial building was studied; these buildings contained spaces that were similarly sized but considerably different from one another in terms of usage and type. When the loads in different spaces differed greatly from one another, temperature conditions could not be controlled using centralized air handling. The higher the desired degree of independent control, the greater is the necessary extent of system distribution. In variable airf low rate air conditioning systems that do not have the facility for reheating, the air conditioning unit produces only either heating or cooling air. Thus it is necessary to choose a single space in which the air will 'realize' the desired situation. In such circumstances it is not possible to achieve accurate control over time temperature conditions in the other spaces. In a commercial building the control is not so much dependent on the time of year, but in particular on variation of the internal loads.

## 3202 Transportation

*Refer also to citation(s) 34244, 34970*

**34350** (ANL/CP–73909) **Maglev system design considerations.** Coffey, H.T. Argonne National Lab., IL (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9108115–2: 1991 Society of Automotive Engineers (SAE) future transportation technology conference, Portland, OR (United States), 5-8 Aug 1991). Order Number DE92000239. Source: OSTI; NTIS; GPO Dep.

Although efforts are now being made to develop magnetic levitation technologies in the United States, they have been underway for two decades in Germany and Japan. The characteristics of maglev systems being considered for implementation in the United States are speculative. A conference was held at Argonne National Laboratory on November 28–29, 1990, to discuss these characteristics and their implications for the design requirements of operational systems. This paper reviews some of the factors considered during that conference.

**34351** (ANL/ESD–9) **Forecast of transportation energy demand through the year 2010.** Mintz, M.M.; Vyas, A.D. Argonne National Lab., IL (United States). Apr 1991. 101p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE92000222. Source: OSTI; NTIS; GPO Dep.

Since 1979, the Center for Transportation Research (CTR) at Argonne National Laboratory (ANL) has produced baseline projections of US transportation activity and energy demand. These projections and the methodologies used to compute them are documented in a series of reports and research papers. As the lastest in this series of projections, this report documents the assumptions, methodologies, and results of the most recent projection – termed ANL-90N – and compares those results with other forecasts from the current literature, as well as with the selection of earlier Argonne forecasts. This current forecast may be used as a baseline against which to analyze trends and evaluate existing and proposed energy conservation programs and as an illustration of how the Transportation Energy and Emission Modeling System (TEEMS) works. (TEEMS links disaggregate models to produce an aggregate forecast of transportation activity, energy use, and emissions). This report and the projections it contains were developed for the US Department of Energy's Office of Transportation Technologies (OTT). The projections are not completely comprehensive. Time and modeling effort have been focused on the major energy consumers – automobiles, trucks, commercial aircraft, rail and waterborne freight carriers, and pipelines. Because buses, rail passengers services, and general aviation consume relatively little energy, they are projected in the aggregate, as "other" modes, and used primarily as scaling factors. These projections are also limited to direct energy consumption. Projections of indirect energy consumption, such as energy consumed in vehicle and equipment manufacturing, infrastructure, fuel refining, etc., were judged outside the scope of this effort. The document is organized into two complementary sections – one discussing passenger transportation modes, and the other discussing freight transportation modes. 99 refs., 10 figs., 43 tabs.

**34352** (CONF-911213–7) **Study of thermoelectric technology for automobile air conditioning.** Mathiprakasam, B. (Midwest Research Inst., Kansas City, MO (United States)); Heenan, P.; Mei, V.C.; Chen, F.C. Oak Ridge National Lab., TN (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) annual winter meeting: Atlanta, GA (United States); 1-6 Dec 1991. Order Number DE91017948. Source: OSTI; NTIS; GPO Dep.

An analytical study was conducted to determine the feasibility of employing thermoelectric (TE) cooling technology in automobile air conditioners. The study addressed two key issues – power requirements and availability of thermoelectric materials. In this paper, a mathematical model was developed to predict the performance of TE air conditioners and to analyze power consumption. Results show that the power required to deliver a cooling capacity of 4 kW (13,80 Btu/h) in a 38°C (100°F) environment will be 9.5 kW electric. Current TE modules suitable for air conditioning are made of bismuth telluride. The element tellurium is expected to be in short supply if TE cooling is widely implemented for auto air conditioning; some options available in this regard were studied and presented in this paper.

**34353** (NAL-TR–1076) **Investigation of a two-dimensional hybrid laminar flow control airfoil at high subsonic flow. Part 1.: Aerodynamic characteristics of a basic airfoil NLAM78.** Nonaka, O, (National Aerospace Laboratory, Tokyo (Japan)); Ishida, Y.; Sato, M.; Kanda, H. National Aerospace Lab., Chofu, Tokyo (Japan). Aug 1990. 25p. (In Japanese). Order Number DE92709527. Source: OSTI; NTIS (US Sales Only).

This paper describes the results of experimental determination on aerodynamic characteristics of the NLAM78 airfoil section, a natural laminar airfoil designed in Ref. 1, at high subsonic Mach numbers and high Reynolds numbers. The airfoil section was selected as the basic airfoil for the hybrid laminar flow control airfoil study which will be described in the latter paper. The test was executed by using the NAL (National Aerospace Laboratory) two-dimensional wind tunnel in where measurements of the static pressure distribution of the airfoil surface and the wake traverse were carried out. The test result has shown that natural laminar airfoil characteristics are maintained for a flow condition of Mach numbers as high as 0.8 and angles of incidence up to 1 °, and that the lift to drag ratio takes very high values of 72-85 in the range of Mach numbers up to 0.77. Also it shows that the drag divergence Mach number is about 0.82 in such angles of incidence, and drag creep phenomenon is rarely observed. The flight data show quite satisfying agreement with the result of wind tunnel test. 14 refs., 19figs., 2 tabs.

**34354** (NAL-TR–1077) **Observation of laminar boundary layer transition on light monoplane.** Onuki, T. (National Aerospace Laboratoy, Tokyo (Japan)); Terui, Y.; Kamata, Y.; Kamiya, N. National Aerospace Lab., Chofu, Tokyo (Japan). Sep 1990. 12p. (In Japanese). Order Number DE92709528. Source: OSTI; NTIS (US Sales Only).

For the following two purposes, a series of flight tests was carried out to visualize the boundary layer transition on a light monoplane wing surface. The first purpose is to establish a method confirming the transition location. The method is essential to glove-wing flight tests on development of a natural laminar flow wing or a laminar flow control wing which is expected in the near future. The

second purpose is to support theoretical approach to laminar boundary layer transition through acquisition and accumulation of experimental data on laminar boundary layer transition by flight tests. The transition location was marked out by the sublimation method, in which sublimating chemicals were coated on wings and sublimating patterns were recorded by taking photographs during the flight tests. On the other hand, predictive calculations on the transition location were made on a basis of some theories and semiempirical rules. As a result, the confirmation of the transition location by the practical flight tests was established successfully. The agreement between theoretical and experimental results was very good. The transition Reynolds number was about 1.3 million. 16 refs., 14 figs., 3 tabs.

**34355** (NAL-TR–1082) **Performance of the $N_2H_4$/MMH mixed fuel regeneratively cooled engine.** Ueda, S. (National Aerospace Laboratory, Tokyo (Japan)); Kuroda, Y.; Sakuranaka, N.; Kisaka, K.; Miyajima, H.; Kosaka, K.; Nagashima, R. National Aerospace Lab., Chofu, Tokyo (Japan). Sep 1990. 33p. (In Japanese). Order Number DE92709530. Source: OSTI; NTIS (US Sales Only).

In order to enhance performance of bipropellant apogee engines in artificial satellites, mixed fuel consisting of hydrazine($N_2H_4$) / monomethylhydrazine(MMH) was investigated as fuel accompanied with nitrogen tetroxide(NTO) as oxidizing agent. Experimental regeneratively cooled bipropellant engines with a vacuum thrust of 2000N were applied, in order to evaluate potential performance and cooling improvement with the mixed fuel. The test was conducted with 80% hydrazine-20% MMH mixed fuel as well as with MMH single fuel, utilizing optimized injectors for each fuel. Long duration firing tests of 160 s were conducted to evaluate heat soak back level and demonstrate safe shutdowns of a mixed fuel regeneratively cooled engine. The peak specific impulses of the mixed fuel was 322 s and exceeded 308 s in that of MMH. Regenerative cooling with the mixed fuel seemed to be particularly advantageous, since the temperature increase through the cooling channels was smaller than that of MMH by 20 centigrade or more. No indication of explosion in the coolant channels or manifolds at engine shutdown was observed during long firing tests. 17 refs., 50 figs., 6 tabs.

**34356** (NAL-TR–1087) **Velocity measurements inside the leading edge vortex formed on a delta wing.** Rinoie, K. (National Aerospace Laboratory, Tokyo (Japan)); Iwasaki, A.; Fujita, T.; Fujieda, H. National Aerospace Lab., Chofu, Tokyo (Japan). Nov 1990. 20p. (In Japanese). Order Number DE92709532. Source: OSTI; NTIS (US Sales Only).

For the purpose of improving low-speed aerodynamic characteristics in super high-speed flying wings as a space shuttle et al, an experiment was conducted to comprehend the three dimensional structure of the leading edge vortex formed on the delta wing. The model applied in the experiment was a plane delta wing with a 60 ° sweep. The behavior of the vortex was studied by means of a lift measurement, surface pressure measurement, and flow visualization tests by oil flow method and laser light sheet method. Mean velocities and velocity fluctuations were measured using a laser two-focus velocimeter. From the results of the above measurements, flow patterns of large secondary separation vortexes inside the leading edge vortex were observed. The velocity fluctuations in the separation vortex showed large values at positions having large gradient of mean velocities. The other relationship between the mean velocities and the velocity fluctuations was also revealed. In addition, the problem in the experimental method and measurement errors when a laser two-focus velocimeter was applied in a gust wind tunnel was investigated. 22 refs., 21 figs.

**34357** (NYSERDA–91-5) **New York State technical & economic MAGLEV evaluation: Final report.** New York State Energy Research and Development Authority, New York, NY (United States); Grumman Corp., Bethpage, NY (United States). Jun 1991. 253p. Sponsored by New York State Energy Research and Development Authority, Albany, NY (United States). Source: OSTI; New York State Energy Research and Development Authority, Two Rockfeller Plaza, Albany, NY 12223.

The Energy Authority, the New York State Departments of Transportation, Economic Development, Environmental Conservation and the New York State Thruway Authority sponsored an evaluation of high-speed surface transit options for New York State. This study is the preliminary evaluation of magnetically levitated ground transportation systems (MAGLEV). The evaluation focuses on using the New York State Thruway right-of-way in combination with MAGLEV systems currently in development in Germany and Japan and those proposed for development in the United States. The Energy Authority's goal in cosponsoring this study was to determine if MAGLEV offered the potential to meet future New York State transportation demands cost-effectively, and to evaluate the benefits that the State might expect from supporting MAGLEV technology development and system implementation. According to the preliminary report, substantial economic benefits could accrue to the State through MAGLEV-related research, development, manufacturing and construction. Implementation would have a favorable impact on issues related to transportation, the environment and energy conservation. With the exception of the German Transrapid system, developing a domestic prototype MAGLEV vehicle would take seven to nine years; no insurmountable technical barriers are apparent. EMF shielding (electromagnetic fields) is, however a concern. 39 refs., 71 figs., 26 tabs.

**34358** (ORNL–6672/S1) **Light-duty vehicle summary: First six months of Model Year 1991.** Hu, P.S. Oak Ridge National Lab., TN (United States). Aug 1991. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000520. Source: OSTI; NTIS; GPO Dep.

This summary covers more than fifteen years of light-duty vehicle data (i.e., automobiles and light trucks combined) from model year 1976 through the first six months of model year 1991, on a nameplate level (e.g., Chevrolet Corsica is a nameplate). Included in this summary are estimated sales-weighted fuel economies, sales, and market shares of new automobiles and new light trucks sold in each model year. Comparisons and observations are made on the trends from one model year to the next.

**34359** (VTT-TIED–1157) **Comparison of public transport in Finland and Sweden.** Himanen, V. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Tie- ja Liikennelab.); Permala, A.; Lippoy, R. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Aug 1990. 51p. Order Number DE92704029. Source: OSTI; NTIS (US Sales Only).

In Finland, bus transportation is handled by two fundamentally different systems working in tandem: one based on private enterprise and the other falling within the scope of public-sector economic management The later is the case in the metropolitan area, Turku and Tampere while the former encompasses the remainder of the country. The operation and management of the public transport system in Sweden takes place within the realm of the public sector. Local and district transport in Sweden is generally handled by provincial transport companies, which are jointly owned by the municipalities and dre povincial government. The Swedes use more public transport services than the Finns. This difference is explained by the fact that domestic air travel is more commonly used in Sweden than in Finland. Finland and Sweden are on equal terms as far as the combined use of rail and bus transport is concerned. However, the Finns make more use of buses and Swedes more use of trains. In large cities, the cost level of bus transportation administered and financed by the public sector is about the same in Finland and in Sweden. The cost level of public-sector bus transport system in Sweden is significantly higher than the cost level of Finland's private-sector- based system. In Sweden as a whole, subsidies make up over a half of public transport costs, while in Stockholm, three-quarters of the costs are covered by subsidies. In Finland, bus transportation outside the metropolitan area, Turku and Tampere is essentially free of subsidies paid out of tax revenues.

**34360** (VTT-TIED–1213) **Reliability and life cycle costs of local traffic train battery systems.** Maelkki, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoe- ja Automaatiotekniikan Lab.); Lyytikaeinen, A. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1991. 81p. (In Finnish). Order Number DE92704020. Source: OSTI; NTIS (US Sales Only).

In the Technical Research Centre of Finland (VTT) initiated research program 'Integrated Design of Mechanical Products' a

project was started to study the use of LCC-techniques which so far are not very widely used in the Finnish industry. Eight Finnish companies are participating and partly sponsoring the project which will last in 1989-1991. LCC-methodology makes it possible to take into account the effect of failures and outages on system life time economy. LCC-costs usually consist of the initial investment (technical systems and hardware spares maintenance resources) preventive maintenance costs repair costs plus the costs for losses and outages due to failures and disturbances (e.g. unsold production replacement energy etc.). LCC-analysis can be thus used in design procurement and maintenance planning of technical systems. The DC-battery systems for local traffic trains were selected as the first pilot study. The Finnish State Railways (VR) intended to replace the batteries and battery systems in all the 100 local traffic trains of the Helsinki metopolitan area because the NiCd-batteries had reached the end of their economic life which was estimated to be 20 years. The tender offers for the new battery types had been sent and the acquisition decision had to be reached by the last quarter of 1989. This emphasized gaining of quick and sufficiently reliable results to help the decision making and at the same time getting experience in LCC-techniques. There was a need to use techniques for quick information collection calculation corrections and printing of results. A modern PC-compatible spreadsheet seemed to be the most promising in this respect and was chosen for the first pilot analysis.

**34361** (VTT-TIED--1221) **Transport policy between economy and ecology.** Knoflacher, H. (Technical Univ. of Vienna (Austria)); Himanen, V. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1991. 22p. Order Number DE92704025. Source: OSTI; NTIS (US Sales Only).

Activity patterns within the built-up environment are sustained by the transport system. Both transport system and built-up environment are in their torn sustained by the natural environment. The mass consumption system, in which we live is all the time diminishing the capacity of the natural environment to sustain us. The negative development can already be seen across the Europe. In this paper the transport system is analyzed according to the system-keeping principles of evolution, which are variety, closed circles (recycling), maximum efficiency in using energy and resources, self-regulation and regionalisation. When comparing the modern transport system with the five system-keeping principles of the ecosystem, we can observe an increasing discrepancy between the roles with which life goes about solving problems and the technical and economic solutions used in the transport system. Two factors can be derived from this analysis as the main causes for the discrepancy: The quantity and the speed of traffic. Both factors are developing in a synergetic process which takes no account of the ecosystem. At least in the short run, there are not enough feedbacks for the self-regulation of the transport system to keep the development within the bounds of the environment needed for the dignity of human life. The effortless and unbridled use of energy in the existing transport system indicates that no effective control system is functioning. An open question is whether our insight is good enough and our ability to learn is faster than the damaging process brought on by uncontrolled development.

## 3203 Industrial and Agricultural Processes

*Refer also to citation(s) 33794, 33846, 33887, 33888, 33889, 33890, 33904, 34249, 34512, 34735, 34736, 34999, 35000, 35001*

**34362** (CONF-8906112--, pp. 62-70) **A methodology for establishing surface area targets for the synthesis of constrained heat exchanger networks.** Viswanathan M. (Massachusetts Inst. of Tech., Cambridge (USA)); Evans, L.B. Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

A method for establishing surface area targets for the synthesis of heat exchanger networks is presented. It is based on minimizing a nonlinear objective function subject to linear constraints. The formulation is developed from the transshipment model. Both, vertical and criss-cross matches are considered and the area target can be established even when the heat transfer coefficients are nonuniform and in the presence of forbidden match constraints. The method can be extended to establish surface area targets when the heat exchanger material costs are nonuniform. The maximum error encountered in the area estimation was 15%.

**34363** (CONF-8906112--, pp. 71-78) **Complex dynamics and chaos in continuous and semibatch solution polymerization reactors.** Teymour, F. (Univ. of Wisconsin, Madison (USA)); Ray, W.H. Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

The dynamic behavior of the solution polymerization in semibatch and continuous stirred tank reactors (CSTR) has been studied. For the CSTR, modeling results and experimental verification confirmed the existence of multiple steady states and limit cycle attractors for a laboratory scale reactor. If one uses this model in order to predict the behavior of full scale industrial reactors, very complex structures arise. Examples include multiple stable periodic orbits, isolas, of periodic solutions, non-monogeneous periodic oscillations and cascading period doublings leading to chaos. The structure of the strange attractor is illustrated and characterized using different methods (e.g. Poincare sections, Liapunov exponents, successive iterate maps,...). Numerical experiments in the chaotic regime reveal the presence of numerous periodic windows with odd period oscillations, in some of these chaos is seen to disappear and reemerge through the intermittency mechanism. A mechanism of chaos formation through hysterisis and preperiodicity is observed and is shown th be related to a tangent bifurcation similar to that leading to intermittency. Analysis of semibatch reactors shows that all of these phenomena are possible there as well.

**34364** (CONF-8906112--, pp. 54-61) **Integration of redesign methodologies for chemical processes.** Biegler, L.T. (Carnegie Mellon Univ., Pittsburgh, PA (USA)); Grossmann, I.E.; Thompson, G.L.; Westerberg, A.W. Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Process redesign, commonly known as retrofit, is a major task in the chemical industries. However, most systematic design strategies have been developed for new process and often do not apply. This report discusses the development of systematic design methodologies for the redesign of chemical processes. This integrated approach deals with a broad range of problems in process redesign. Here the authors discuss progress in the following areas: Development of Efficient Optimization Algorithms for Discrete and Continuous Variables; Redesign Strategies for Controllability; Redesign Strategies for Energy Management Systems; Redesign Strategies for Distillation-Based Separations Systems; Redesign Strategies for Fixed Topology Flowsheets. The discussion is organized from more conceptual levels to process specific applications. For these applications the authors exploit the structure of the physical system in order to develop insights that allow more effective solution of the synthesis problem. Future work will concentrate on extending research results from these areas toward an integrated strategy for plant wide planning and optimization.

**34365** (CONF-8906112--, pp. 114-120) **Modifying process flowsheets to improve process control.** Douglas, J.M. (Univ. of Massachusetts, Amherst (USA)). Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Conventional control focuses on the dynamic control of the individual process units and attempts to ignore the interactions in the process. An alternate approach is to start by considering the effect

of persistent disturbances (from the conncections with the environment) on the steady state performance of the plant. If the plant has a poor steady state response, then the flowsheet can be modified. Similarly, when the author is screening alternative flowsheets at the conceptual stage of a process design, he can use the estimated response to disturbances as an additional screening tool for selecting the best flowsheet. A computer code that assesses the need for flowsheet modifications is being developed.

**34366** (CONF-8906112–, pp. 121-128) **Screening steady-state control structures for distillation system design.** De Guiran, M.D. (Univ. of Massachusetts, Amherst (USA)); Malone, M.F. Argonne National Lab., IL (United States). [1989]. DOE Contract FG02-87ER13676. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

The steady-state control of complex distillation columns is examined using the relative gain array. Rapid estimates of the gains were made using orthogonal collocation to construct performance models; the authors also give criteria for selecting the number of collocation points and show how to apply the technique to nonideal binary mixtures. Sequences containing sidestream columns are often economically attractive compared to simple sequences. Thirteen different control variable pairings were examined for six different designs of a sidestream column separating a ternary mixture. A single scheme was found to be the most promising; this pairs the composition of the lightest component in the distillate with the ratio of the distillate to vapor flow at the top of the column, the middle component composition in the sidestream with the sidestream flow rate and the composition of the heaviest component in the bottom with the bottoms flow rate.

**34367** (CONF-8906112–, pp. 129-136) **A topological recipe for predicting residue curve maps for multicomponent reacting mixtures.** Doherty, M.F. (Univ. of Massachusetts, Amherst (USA)). Argonne National Lab., IL (United States). [1989]. DOE Contract FG02-88ER13946. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Residue curve maps are an effective way of representing phase equilibria in nonideal multicomponent mixtures. They have the advantage that infeasible separations are easily detected by the presence of distillation boundaries. In this paper a simple topological method is outlined for prredicting the presence or absence of distillation boundaries in multicomponent reacting mixtures. The main advantage of the method is that it does not require any phase equilibrium data or models beyond the composition and boiling temperature of each azeotrope and pure component in the mixture.

**34368** (CONF-9108169–1) **Experimental analysis of direct-expansion ground-coupled heat pump systems.** Mei, V.C.; Baxter, V.D. Oak Ridge National Lab., TN (United States). Sep 1991. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International Energy Agency (IEA) workshop on ground-source heat pumps; Montreal (Canada); 12-13 Aug 1991. Order Number DE92000420. Source: OSTI; NTIS; GPO Dep.

Direct-expansion ground-coil-coupled (DXGC) heat pump systems have certain energy efficiency advantages over conventional ground-coupled heat pump (GCHP) systems. Principal among these advantages are that the secondary heat transfer fluid heat exchanger and circulating pump are eliminated. While the DXGC concept can produce higher efficiencies, it also produces more system design and environmental problems (e.g., compressor starting, oil return, possible ground pollution, and more refrigerant charging). Furthermore, general design guidelines for DXGC systems are not well documented. A two-pronged approach was adopted for this study: (1) a literature survey, and (2) a laboratory study of a DXGC heat pump system with R-22 as the refrigerant, for both heating and cooling mode tests done in parallel and series tube connections. The results of each task are described in this paper. A set of general design guidelines was derived from the test results and is also presented. 12 refs., 11 figs., 1 tab.

**34369** (DOE/CE/40637–T9) **Fundamental studies of black liquor combustion: Report No. 4, Phases, 2, 3, and 4: Final report, December 1987–December 1989.** Clay, D.T.; Lien, S.J.; Grace, T.M.; Brown, C.A.; Empie, H.L.; Macek, A.; Amin, N.; Charangundla, S.R. Institute of Paper Science and Technology, Atlanta, GA (United States). Chemical Recovery Group; National Inst. of Standards and Technology, Washington, DC (United States). Center for Chemical Engineering. Mar 1990. 180p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-83CE40637. Order Number DE91018580. Source: OSTI; NTIS; GPO Dep.

The fundamentals of black liquor combustion are being studied in a project being carried out for the US Department of Energy by the Institute of Paper Science & Technology (IPST, formerly the Institute of Paper Chemistry) and the National Institute of Science & Technology (NIST, formerly the National Bureau of Standards). The project was divided into four phases. This report covers the completion of Phase 1 (in-flight processes), the results of all of the work on Phase 2 (char bed processes), Phase 3 (fume processes), and Phase 4 (furnace simulation). 41 refs., 62 figs., 30 tabs.

**34370** (DOE/CE–40762T-H2) **Characterization of major waste data sources.** Cordes, R.; Eisenhauer, J. Energetics, Inc., Columbia, MD (United States). 3 Sep 1991. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC01-87CE40762. Order Number DE92000600. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) recently initiated the Industrial Waste Reduction Program, which seeks to develop and commercialize waste reduction technologies and practices that will reduce industrial energy use. The Industrial Waste Reduction Program, like the other programs under DOE's Office of Industrial Technologies (OIT), works with industry to focus research and development resources according to industry needs and market opportunities. The Program consists of five fundamental elements: industrial waste characterization, opportunity assessments, technology research and development, technology and information transfer, and, institutional analysis. This report is a product of efforts initiated under the first of these program elements, Industrial Waste Characterization. Its purpose is to increase understanding of the types and magnitudes of industrial waste streams. In particular, this report presents the key characteristics of selected waste, energy, and economic data sources in an effort to clarify the scope, consistency, and limitations of the data. It is expected that this information will be used in another element of the program, Opportunity Assessments. That effort will identify priority technology needs by evaluating the available data; expert advice from industry, government, and academia; and independent analyses. 33 refs.

**34371** (DOE/EIA–0515(88)) **Manufacturing fuel-switching capability, 1988.** USDOE Energy Information Administration, Washington, DC (United States). Office of Energy Markets and End Use. Sep 1991. 132p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000615. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

Historically, about one-third of all energy consumed in the United States has been used by manufacturers. About one-quarter of manufacturing energy is used as feedstocks and raw material inputs that are converted into nonenergy products; the remainder is used for its energy content. During 1988, the most recent year for which data are available, manufacturers consumed 15.5 quadrillion British thermal units (Btu) of energy to produce heat and power and to generate electricity. The manufacturing sector also has widespread capabilities to switch from one fuel to another for either economic or emergency reasons. There are numerous ways to define fuel switching. For the purposes of the Manufacturing Energy Consumption Survey (MECS), fuel switching is defined as the capability to substitute one energy source for another within 30 days with no significant modifications to the fuel-consuming equipment, while keeping production constant. Fuel-switching capability allows manufacturers substantial flexibility in choosing their mix of energy sources. The consumption of a given energy source can be maximized if all possible switching into that energy source takes place.

The estimates in this report are based on data collected on the 1988 Manufacturing Energy Consumption Survey (MECS), Forms 846 (A through C). The EIA conducts this national sample survey of manufacturing energy consumption on a triennial basis. The MECS is the only comprehensive source of national-level data on energy-related information for the manufacturing industries. The MECS was first conducted in 1986 to collect data for 1985. This report presents information on the fuel-switching capabilities of manufacturers in 1988. This report is the second of a series based on the 1988 MECS. 8 figs., 31 tabs.

34372 (EGG-M–90299) **Solvent substitution with non-chlorinated biodegradable solvents.** Carpenter, C.A. (Air Force Engineering and Services Center, Tyndall AFB, FL (United States). Engineering and Services Lab.). EG and G Idaho, Inc., Idaho Falls, ID (United States). [1990]. 13p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-9007145–4: SUR/FIN '90: 77th American Electroplaters and Surface Finishers Society (AESF) annual technical conference, Boston, MA (United States), 9-12 Jul 1990). Order Number DE91018708. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Solvents and cleaners are used at the Air Force Air Logistics Centers in aircraft maintenance for removing wax, grease, oil, carbon and paint before repairing or electroplating the parts. Many, such as 1,1,1-trichloroethane, cannot be treated in industrial waste treatment plants (IWTPs) that remove organic chemicals by biological processing. These solvents will soon be strictly controlled by the EPA, and their use will become more expensive and less desirable. Chemical substitution with nontoxic or biodegradable solvents is the solution to the present problems with solvent cleaning. The substitution chemicals ultimately selected will be effective for removing greases, oils, carbon and many other soils and may be treated in IWTP. However, some of the solvents may require water rinsing of the parts after treatment to ensure a clean surface. In other cases, enhancement such as ultrasonics, spray washing or agitation may be required. 8 refs., 7 tabs.

34373 (ENEA-RTI-INT–91-01) **Desalination of sea and brackish water.** Angelini, B.M.; Mallone, M. ENEA, Rome (Italy). Apr 1991. 52p. (In Italian). (RTI-INT–91-01). Order Number DE92705885. Source: OSTI; NTIS (US Sales Only).

Through an assessment of available, world, fresh water resources, and current and future fresh water demand in the agricultural, industrial and domestic sectors, marketing possibilities are indicated for desalination plants. A review is then made of the state-of-the-art in desalination technology with the aim of identifying the relative advantages and disadvatages of the various types of processes currently in use, or under development. These include: multi-stage flash desalination, multiple effect desalination, mechanical vapour compression, and inverse osmosis. Attention is given to an inverse osmosis process incorporating an energy recovery system and consideration is given to the use of nuclear power as a desalination process energy source. A survey is made of desalination plants making use of solar energy. For each process, the paper describes the key design, operation and performance features. Relative plant construction, operating and production costs are indicated along with energy incidence upon production costs.

34374 (ENET–8900188/1) **Increase in efficiency of an electrolytic cell by suppressing the oscillations from the mass of liquid aluminium.** Descloux, J. (Ecole Polytechnique Federale, Lausanne (Switzerland)); Rappaz, J.; Romerio, M. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Oct 1989. 15p. (In French). Order Number DE92714222. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

This report describes mathematically the stationary conditions of the liquids and their surface areas. The algorithm developed for it was installed in a computer code, which enabled the speed and pressure profiles to be calculated on an iterative path. In the problem area of stability part results were achieved, whereby the perturbation theory was used. An expression was derived for the imaginary part of the frequencies used in the Fourier analysis of the different fields. It was possible by using numerical methods to provide an answer to the question of stability of the system within the scope of the model used. 3 figs., 16 refs.

34375 (ETDE-mf–2711163) **Control of steam turbine sets in interconnected power systems.** Krutemeier, F. Technische Univ. Braunschweig (Germany). Fakultaet fuer Maschinenbau und Elektrotechnik. 12 Oct 1990 157p. (In German). Order Number DE92711163. Source: OSTI; NTIS (US Sales Only).

Work treats turbine control with fossil fuels in steam power stations. Control contains the speed control of the turboset, output control and frequency control through maintenance of a pre-set output participation in the load operation. The investigation handles the operation above all in small grids, i.e. typical industrial grids. This mode of operation is referred to as interconnected power system operation. In the first section, dynamic models which are used for non-linear simulation of the overall system are described. A linear analytical model then follows for computation of transfer behaviour, which corresponds to the experiences from measurements in industrial grids and is derived from literature models. The third section shows the design of an observer for the total torque of the turboset which is not available as a measuring quantity. A torque closed-loop control system which linearizes operating point dependent turbine behavior is designed with this computed actual value for the turbine. The controller parameters are adapted through controlled adaptation. (orig./GL).

34376 (EUR–12914) **Absorption-driven multiple effect evaporator: Final report.** Yanniotis, S. (Hellas Energy, Athens (Greece)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Hellas Energy, Athens (Greece). 1990. 83p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3E-0138-GR. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

In this project an absorption-driven evaporator coupled with a conventional two effect evaporator for the regeneration of the absorptive solution has been constructed and studied. Detailed physical, thermodynamic and corrosion behavior data were collected from the literature for aqueous lithium chloride, lithium bromide and sodium hydroxide solutions. Using these data three absorption-driven evaporators were designed. It was shown that the three systems are equivalent in terms of energy and exergy consumption but the sodium hydroxide system requires less heat transfer area. The feasibility of absorption-driven multiple effect evaporators was demonstrated experimentally using initially a two-effect absorption-driven falling film evaporator coupled with a two effect steam-heated regenerator. With the experience gained from the first prototype, a scaled-up unit consisting of a four effect falling film evaporator with 100 kg/h nominal evaporative capacity and a two effect regenerator with 25 kg/h evaporative capacity was built. The overall heat transfer coefficient of the absorption-driven effect was measured using sodium hydroxide solutions as absorptive medium. The coefficient varies between 600 and 1200 W/m$^2$ C depending mainly on the temperature difference. The energy consumption of the experimental unit has been measured and compared with the energy requirements of the same unit when operated as conventional steam-heated evaporator. A preliminary economic assessment shows that the payout period of a commercial absorption-driven evaporator could be from 0.99 to 3.86 years for various economic and technical scenarios.

34377 (EUR–13142, pp. 15-24) **The European Communities Activities in the field of energy efficiency.** Molina, G. (Commission of the European Communities, Brussels (Belgium)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The energy cost of the European agrofood industry is estimated at 3,000 MECU per annum. The possibility of energy savings with existing technologies has been estimated to be about 15 percent. The Commission of the European Communities (CEC) is interested in the development of new technologies that will not only provide

economic benefits but will also minimize impacts on the environment. The CEC has demonstrated energy saving techniques in a number of industrial processes and these are provided in tables. The Commission has also developed a new program called THERMIE for the promotion of community energy technologies. THERMIE will cover the efficient use of energy, renewable energies, coal and other solid fuels, and oil and gas. THERMIE will promote innovation projects, dissemination projects, and targeted projects. In addition it will provide consolidation activities such as technology and market assessments. Preferences will be given to joint venture projects, small and medium size enterprises, regional development and projects with a positive environmental impact. CEC's dissemination strategy is discussed in detail.

**34378** (EUR–13142, pp. 59-64) **Utilization of reverse osmosis membranes process system to correct a grape must with low sugar content.** Viglia, A. (SnamprogettiBiotecnologie S.p.A., Milan (Italy)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

This paper introduces a new reverse osmosis membrane process system that corrects grape musts with a low sugar content. The process, developed by SnamprogettiBiotecnologie, was sponsored by a partial grant from the European Economic Communities. In addition to a discussion of the technical problems in the production of wines, a cost estimation and economic evaluation of this particular concentration technology is provided. Direct and indirect energy savings are discussed.

**34379** (EUR–13142, pp. 65-76) **Improving of energy tie up using the high temperature cooling crystallization.** Issle, F. (Suedzucker AG Mannheim/Ochsenfurt, Regensburg (West Germany)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

This paper describes the energy savings expected in the use of a high temperature cooling crystallization process of sugar beets. Compared with the conventional evaporation crystallization process, an energy savings of 50% is possible. The process has been carried out at the Regensburg works of Suedzucker AG Mannheim/Ochsenfurt, Federal Republic of Germany. Data from thirteen trials are reported with results showing higher crystal content and lower energy demand than with the conventional process. Problems with quality, crystal content, and crystal size are expected to be solved with more suitable conditions and installations.

**34380** (EUR–13142, pp. 85-95) **Automatic control of grain dryers.** Bruce, D.M. (AFRC Inst. of Engineering Research, Bedford (England)); McFarlane, N.J.B. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Crop drying consumes a large amount of energy. On an arable farm using conventional cultivation, fuel for drying represents 43% of the total fuel used to produce the crop. In the U.K., savings in drying cannot be accomplished by harvesting crops later at a lower moisture content. Studies have shown higher yields and greater quality of crops harvested early. This paper outlines the development of a control system for minimizing the effect on the output moisture of fluctuations in input conditions in a continuous-flow dryer. A computer model of the drier was used to help determine the parameters for a feedback control system which has been field tested and for a feedback plus feedforward control system which has been tested in the laboratory.

**34381** (EUR–13142, pp. 120-126) **Cogeneration and energy use from by products in distilleries.** Bonfitto, E. (ERSA, Avezzano (Italy)); Jacoboni, S. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The use of steam and electric power in distilleries accounts for about 20% of the production costs. This paper discusses the feasibility of installing co-generation plants which use residual biomass of the wine by-products to fuel the combined gas-steam cycle. A fluidized bed boiler is used. The use of vapors from turbo-gas systems in the post-combustion process is also being considered.

**34382** (EUR–13142, pp. 127-135) **Using ultra-osmosis to concentrate residues up to 20% solids using 10% of the energy of conventional methods.** O'Shea, J.A. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The major energy cost in the processing of milk, beet, grains and potatoes in the food industry is the removal of water from the raw material. This paper describes an ultra-osmosis process that is very energy efficient. The process is based on a membrane with rejection characteristics intermediate between those common in ultrafiltration and reverse osmosis. It is estimated that the ultra-osmosis process could operate at 10% of the energy cost of thermal vapor recompression which is the conventional method of evaporating water industrially.

**34383** (EUR–13142, pp. 153-164) **Spent grain as energy source for breweries.** Scharf, P. (Technical Univ. of Munich, Freising (West Germany)); Meyer-Pittroff, R. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

About 1.7 million tons of spent grain are produced from brewing operations each year in the Federal Republic of Germany. Because there is more spent grain than can be sold as cattle fodder, other uses for this product are being sought. These include composting, methane generation, and direct combustion. Researchers are using anaerobic fermentation as a means of producing biogas and using waste energy from the brewery to heat the fermenter. Combustion of spent grain can give a net energy of 12.8 MJ per kg dry grain. With biogas production, about 15-20% of the whole primary energy or 50% of the primary energy used in the boiling house could be substituted by the biogas.

**34384** (EUR–13142, pp. 172-179) **Continuous sterilization of tinned food along with energy conservation.** Breywisch, D. (Kraftanlagen Aktiengesellschaft, Heidelberg (West Germany)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The HYDROKLAV, a new and innovative system for continuous sterilization, was installed at Richter and Greif fish conserves

producers in Cuxhaven, Germany, with start-up, testing and measuring being underway right now. This technology ensures a 60 to 70% live steam and also a substantial water conservation, as compared to the conventional autoclave. Moreover, continuous operation makes it possible to exactly match the sterilization process with other upstream and downstream production cycles. In this application, the cans are transported through a piping system, with the water in the piping being the transport fluid and also the heating and/or cooling fluid. Hot and cold water flows in closed circuits, each, keeping in this way energy and water losses at a minimum. The measuring phase of this project that gets financial support from the EC has not yet advanced far enough to furnish exact data on energy and fluid consumption.

**34385** (EUR–13142, pp. 180-187) **The application of moisture measurement at microwave frequency for high-capacity dryers.** Sembery, P. (Univ. of Agricultural Sciences, Goedoello (Hungary)); Farkas, I. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

In Hungary, nearly 80% of the million tons of grain produced annually is dried before storage. Agricultural drying requires 10-15 PJ, which is about 20% of the country's annual energy consumption. Research continues for better use of air drying, use of solar drying and for better instrumentation. This paper reports the development of a system for automatic regulation of crossflow dryers for use in drying grain. A microwave moisture meter, developed by the authors, is an important part of the system. In addition, a system is described for the drying of hay that utilizes solar energy for a preheating unit. The system recommended is an indirect (water flow) solar system. It consists of flat plate collectors with water media for a multi-purpose operation; fixed-bed dryer; air-water heat exchanger system through which the fans force the drying air; and storage, which serves for a technological hot water storage as well as an energy storage of the system. The required temperature of drying air must be ensured from direct solar, then stored solar and only at the very end from other heat sources. A back up heat supply must be available.

**34386** (EUR–13142, pp. 196-203) **Drying by water vapour.** Madsen, R.F. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Drying by water vapor is an economically attractive type of drying, because drying by vapor produces almost the same amount of vapor as the amount of used steam. This means that water-vapor-atmosphere drying can operate in series with normal multi-stage evaporators. Where such a drier can be integrated into the energy scheme, the energy used for drying can be reduced to a fraction of the energy used in, for example, a directly fired drier. A fluidized bed drier has been developed for the drying of beet pulp. The drier is supplied with 12 bar steam and produces normally 3 bar vapor which is used in the evaporator in the sugar factor. The drier prevents all environmental problems, because the condensate is used in the sugar factory for extraction, and there is no air-pollution direct from the drier. For syrups which can be evaporated to at least 90% dry substance at 100-110C, a special vacuum-vapor drier has been developed.

**34387** (EUR–13142, pp. 209-217) **Reduction of energy consumption of the milk powder production by computer optimization.** Straatsma, J. (Netherlands Inst. for Dairy Research, Ede (Netherlands)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Concentration and drying are two important unit operations in the milk powder production. Milk is concentrated with a multi-effect evaporator to about 50% dry matter. Additional water removal takes place with a two stage or multi stage dryer. The first stage is a spray dryer, the next stages are generally fluidized beds. Particularly the drying process is an energy consuming operation. Recent years energy savings are realized by heat recovery. This form of energy saving did not influence the drying process. More energy can be saved by changing the process conditions. These changes influence also the properties of the powder produced. A drying model is developed to describe the relations between energy consumption of the drying process, process conditions and properties of the powder produced. The model is used for the optimization of process conditions to produce, at minimal energy consumption, powder having to meet specific quality demands. An interactive computer program for Personal Computers named DRYSPEC2 is developed for application in the dairy industry. Calculations with the model and experiences with industrial installations pointed out energy savings of 10% and more are attainable with existing equipment.

**34388** (EUR–13142, pp. 227-233) **Energy saving in pneumatic dryers.** Barr, D.J. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

This paper reviews the various techniques at present in use to maximize the efficiency of pneumatic dryers and considers the ways in which energy can be saved. These include careful operation and direct firing where suitable and the benefits of keeping losses to a minimum by recycling exhaust gases in a closed circuit dryer are highlighted. Some more advanced ideas for saving energy in pneumatic dryers are also discussed including heat recovery and the use of cogeneration systems employing the exhaust from a boiler or gas turbine as the dryer heat source. Future developments are mentioned including drying in high humidity atmospheres with condensing heat recovery systems for the exhaust vapors.

**34389** (EUR–13142, pp. 248-256) **Experience of energy efficient dryers and evaporators in the UK food and drink industry.** Mann, P.A.G. (Energy Technology Support Unit, Harwell (England)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Drying and evaporating processes, within the food and drink industries, consume a significant proportion of the total energy used. The EEO aims to advance and spread ways of improving the efficiency with which energy is used in the UK. Through the Best Practice program of the EEO, information is made available which shows comparative energy use within a sector or process, examples of proven energy efficiency measures, practical examples of innovative measures and details of multi-client research and development relevant to energy efficiency. There are four elements of the Best Practice program relating to this information which are Energy Consumption Guides, Good Practice Guides and Case Studies, New Practice and Future Practice. Within the food and drink industries, it is recognized that there are opportunities for promoting the improved energy efficiency of dryers and evaporators. This paper starts with a description of two projects supported by the EEO, one involving a dryer system in a distillery associated with a combined heat and power system and the other showing details of an evaporator with mechanical vapor recompression at a dairy. The

Best Practice program of the EEO is then described in more detail. It is hoped that there will be opportunities for developing joint European case studies and other initiatives in this important area.

**34390** (EUR–13142, pp. 266-275) **New processes for the reduction of energy consumption and water evaporation during meat chilling.** Gigiel, A. (AFRC Inst. of Food Research, Bristol (England)); Holder, D. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

This paper reports the results of a survey of the electricity consumption of chillers in UK slaughter houses and trials of two new chilling processes designed to reduce weight loss and electricity consumption. Energy consumption ranged from 68.8 to 188.6 kJ/kg for beef and from 97 to 360 kJ/kg for pork. Energy consumption was increased when higher air velocities were used as in rapid chilling. The two new processes are ice bank and spray chilling. In Ice Bank Chilling air circulating around the carcasses is cooled by direct contact with water from an ice bank. It is already in use for cooling vegetables and cut flowers. In Spray Cooling a sacrificial layer of water is applied to the carcasses during chilling. This has recently been introduced for beef in the USA and USSR and poultry in Europe. Both processes reduce refrigeration plant size, electricity consumption and cost when compared to conventional and rapid chilling. Weight loss was reduced from 2.37% during conventional chilling to 0.95% during spray and to 1.93% during ice bank chilling.

**34391** (EUR–13142, pp. 286-295) **Diffusive pulp de-watering.** Voss, C. (Suedzucker AG Mannheim/Ochsenfurt (West Germany)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

In German sugar beet factories the energy used for thermic de-watering in conventional pulp drying is about one-third of the total energy consumption. This paper describes a process developed and patented by Suedzucker AG for the diffusive de-watering of beet pulp. The advantages of the process include: lower energy consumption; relatively low investment costs; no emissions; production of excess steam that can be used in sugar production. In addition, a cheap fodder is produced that is easily stored and is willingly accepted by ruminants.

**34392** (EUR–13142, pp. 303-314) **Microfiltration and bactocatch as means to reduce bacteria content in milk and whey.** Larsen, P.H. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation. 1990. (In English, French). (CONF-900363–: Energy innovation and the agro-food industry, Amiens (France), 21-23 Mar 1990). In *Energy innovation and the agro-food industry*. 395p. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

This paper describes a process by which bacteria and spores are removed from milk by microfiltration: they are then eliminated during the high temperature treatment leaving the chemical composition and the functional and organoleptical properties of the raw milk unchanged. Energy consumption and costs are presented in tables.

**34393** (EUR–13185) **Energy in industry: Process technologies: Community non-nuclear energy R and D programme: Energy conservation.** Pilavachi, P.A. (Commission of the European Communities, Brussels (Belgium). Directorate General for Science, Research and Development); Reay, D.A.; Dumon, R. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Commission of the European Communities. Brussels (Belgium). Directorate General for Science, Research and Development. Sep 1990. 13p. Sponsored by Commission of the European Communities, Brussels (Belgium). Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Over 34% of the total primary energy in the Community is used by industry, totaling in excess of 350 million tonnes of oil equivalent (mtoe) per year. Typically half of this total, i.e. 170 mtoe/year, is used in the form of process heat. Energy saving opportunities of considerable magnitude exist for operations in industry which tend to be dedicated to particular processes. Examples of this include improvements which might be made to many major unit operations, such as distillation columns, heat exchangers and reactors. The scale of such improvements varies greatly. Better control strategies, the fitting of heat recovery equipment or improved integration, or the development of new packing are typical options. In some cases the greatest energy savings can be achieved by developing new process routes to specific products or by combining processes. It is probable that in the longer term (in the next ten years or more) the major impact on industrial energy consumption will come from the development of new processes, probably based on new unit operations. An example of this would be the use of "process intensification" (compact designs). It is therefore appropriate that a major component of the strategy adopted by the European Commission for supporting energy R&D in industry is based on the belief that by influencing the direction of basic process technology, improved energy efficiency will result. This is also likely to reduce the environmental impact of industrial plant. The completed industrial projects being funded with a budget of 4.5 MECU within the Third Programme (1985–1988) are briefly described in this Brochure.

**34394** (KTM/E-B–85) **JALO Fuel conversion: Interim report 1988-1990.** Sipilae, K. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 47p. Project KTM-100/881/88. Order Number DE92703968. Source: OSTI; NTIS (US Sales Only).

Finland's energy research programmes.

The programme includes process-technical conversion of spent liquors from the pulping industry, of peat and wood and industrial residues. The aim is to develop novel power plants based on pressurized gasification, by which energy at the pulp mills could be produced more profitably than today. The consumtion of indigenous fuels in Finland could be further increased at power plants based on pressurized gasification if the development work will be successful. Emissions from energy production can be reduced by the new technologies. The fuel consumption and hence also the carbon dioxide emissions will be reduced by about 20 % due to an increase in efficiency. In combined electricity and heat production the savings in electricity will be more than 50 %. The increasing use of bioenergy as such would reduce $CO_2$ emissions from energy production. Other environmental applications are process technical conversion methods for biosludges, wastes and crude tall oil to reduce emissions from their use. The research activities, carried out within nine projects, focus on fundamentals of conversion technologies as well as on laboratory and pilot tests. A number of development projects will be carried out at industrial plants. There are industrial pilot and demonstration plants in operation or under construction in Finland. The pressurized test rigs of the industry and the research institutes are among the first ones in the world. International co-operation is carried on within ILA, EC JOULE and the Nordic Minister Council.

**34395** (KTM/E-B–95) **RAINA Energy-efficient paper production: Interim report 1988-1990.** Paulapuro, H. (Helsinki Univ. of Technology, Espoo (Finland). Lab. of Paper Technology); Komppa, A. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 27p. Project KTM-200/881/87. Order Number DE92703966. Source: OSTI; NTIS (US Sales Only).

Finland's energy research programmes.

The goal of the five-year RAINA programme is to optimize the utilization of energy in the papermaking process. So far six research projects and twelve joint development projects have been financed by the programme. The total funding of the programme during its five-year period amounts to about 60 million FIM, of

which the share of the Ministry of Trade and Industry is slightly less than a half. The paper and board industry consumes more than ten per cent of the total electric energy in Finland. Lately, the fuel consumed by the branch has gone down slightly but the consumption of electricity is still increasing. As Finland is at a great distance from markets, the quality of the products must be high enough to allow sufficient competitiveness. The consumption of electricity increases with increasing degree of working up. According to the results from the RAINA research projects up to now it is obvious that the specific energy consumption in certain subprocesses can be significantly reduced. The most promising projects deal with the effectiveness of infrared drying, optimization of the vacuum system, increase of the forming consistency and control of the wet end chemistry.

34396 (KTM/E-B–97) **KUITU Energy-efficient mechanical pulping: Interim report 1988-1990.** Sundholm, J. (Finnish Pulp and Paper Research Inst., Espoo (Finland)). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 45p. Project KTM-201/881/87. Order Number DE92704049. Source: OSTI; NTIS (US Sales Only).

Finland's energy research programmes. Published also in Finnish Report no B:96.

The aim of the KUITU or FIBRE progranmme is to raise the competitiveness of papermakers and manufacturers of related equipment through more economical use of energy. The targets to be reached by 1993 are to find ways of reducing, through process modifications, the specific energy consumption in mechanical pulping by 10-20 %, to determine the energy-saving potential of a selected number of new pulping processes and to establish the theoretical limits for energy saving in mechanical pulping. In practice this would mean cutting the growth in energy consumption by 3-4 percentage points by 1995 and by 6-10 percentage points by the year 2000. As the programme did not begin until spring 1989 onlyafewresultsareso far available. Some directly exploitable results have been obtained, especially in the coorporate sector, although it is too early to predict how well the programme's targets are likely to be met. At this stage, when most projects are only half completed, isolated results can be presented, but there is not yet enough material to provide an overall picture. This interim report describes the situation and results from research projects and company projects. Research has focused on investigating the basic mechanisms of the groundwood and TMP processes and on the potential of a number of completely new pulping processes. In the corporate sector, the accent has been on improving existing processes. The results that can be utilized in practice concern development of the super-pressure groundwood process and the selective plate patterns used in TMP processes.

34397 (LA-UR–91-2991) **Waste minimization via destruction of hazardous organics.** Austin, L.R. Los Alamos National Lab., NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109259–5: 1. international congress on environmentally conscious manufacturing, Santa Fe, NM (United States), 18 Sep 1991). Order Number DE92000210. Source: OSTI; NTIS; INIS; GPO Dep.

Los Alamos National Laboratory is developing technologies that are capable of destroying hazardous organics, that is, converting them basically to water and carbon dioxide. If these technologies were incorporated into the main processing operation where the waste is produced, then the volume and toxicity of the hazardous or mix hazardous waste generated would be significantly reduced. This presentation will briefly discuss some of the waste treatment technologies under development at Los Alamos National Laboratory focused on destroying hazardous organics.

34398 (LA-UR–91-3028) **Recent trends in waste-reduction efforts in the US manufacturing sector.** Tsuji, K.S. Los Alamos National Lab., NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109259–6: 1. international congress on environmentally conscious manufacturing, Santa Fe, NM (United States), 18 Sep 1991). Order Number DE92000197. Source: OSTI; NTIS; GPO Dep.

Recent trends in pollution-control by the US manufacturing sector reveal that a multitude of "in process" measures are taken to generate less waste rather than treating it afterwards. The measures utilized are highly variable across sectors. Sectors that produce the largest shares of waste and spend the greatest proportion of capital outlays on pollution abatement are the most commonly reported as being involved in pursuing waste-reduction. Despite advances in waste-reduction efforts, expenditures are still mostly for "end-of-pipe" measures. 13 refs.

34399 (LBL–29749) **Analysis of energy use in building services of the industrial sector in California: A literature review and a preliminary characterization.** Akbari, H.; Borgers, T.; Gadgil, A.; Sezgen, O. Lawrence Berkeley Lab., CA (United States). Apr 1991. 81p. Sponsored by USDOE, Washington, DC (United States); California Inst. for Energy Efficiency, CA (United States). DOE Contract AC03-76SF00098. Order Number DE92000662. Source: OSTI; NTIS; GPO Dep.

Energy use patterns in many of California's fastest-growing industries are not typical of those in the mix of industries elsewhere in the US. Many California firms operate small and medium-sized facilities, often in buildings used simultaneously or interchangeably for commercial (office, retail, warehouse) and industrial activities. In these industrial subsectors, the energy required for "building services" to provide occupant comfort and necessities (lighting, HVAC, office equipment, computers, etc.) may be at least as important as the more familiar process energy requirements – especially for electricity and on-peak demand. In this report, published or unpublished information on energy use for building services in the industrial sector have been compiled and analyzed. Seven different sources of information and data relevant to California have been identified. Most of these are studies and/or projects sponsored by the Department of Energy, the California Energy Commission, and local utilities. The objectives of these studies were diverse: most focused on industrial energy use in general, and, in one case, the objective was to analyze energy use in commercial buildings. Only one of these studies focused directly on non-process energy use in industrial buildings. Our analysis of Northern California data for five selected industries shows that the contribution of total electricity consumption for lighting ranges from 9.5% in frozen fruits to 29.1% in instruments; for air-conditioning, it ranges from nonexistent in frozen fruits to 35% in instrument manufacturing. None of the five industries selected had significant electrical space heating. Gas space heating ranges from 5% in motor vehicles facilities to more than 58% in the instrument manufacturing industry. 15 refs., 15 figs., 9 tabs.

34400 (LBL–30836) **Environmentally sound irrigated agriculture in the arid west: New challenges for water resources planners and environmental scientists.** Quinn, N.W.T. Lawrence Berkeley Lab., CA (United States). Apr 1991. 9p. Sponsored by Department of the Interior, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9104302–1: Conference on environmentally sound agriculture, Orlando, FL (United States), 16-18 Apr 1991). Order Number DE92000807. Source: OSTI; NTIS; GPO Dep.

This is an exciting time for water resources planners and environmental scientists in the State and Federal Agencies in California. The growing environmental awareness of the public has raised their interest in the manner by which water is managed and allocated. Current and future impending water shortages are challenging engineers and planners to make sound policy and system operations decisions to maximize the utility of scarce water resources while ensuring that the environment within which we live is adequately protected to the satisfaction of an informed public. New and innovative decision support systems are needed to meet these challenges that are flexible, comprehensible and accurate and which allow the public a more visible role in the planning process. These changes may help to bring the agricultural and environmental communities closer together in finding solutions to water resources problems and wrest policy making for water resources management out of the hands of lawyers and the courts and restore it to those whose livelihoods are affected by the intentions of these policies. 4 refs.

**34401** (NEI-DK-644) **Centre for cooling technology.** Stannow, J.; Minds, G.; Danig, P.O. PA Consulting Group A/S, Lyngby (Denmark). Jun 1991 138p. (In Danish). Contract ENS-151/90-0033. Order Number DE92703897. Source: OSTI; NTIS (US Sales Only).

EFP-90.

An investigation by an international management and technology consultancy on the feasibility of establishing a Danish center for research and development on cooling systems which would also cooperate with research centers abroad and be responsible for marketing. The Danish government wishes that research in this area should be intensified. Interviews were carried out within larger Danish firms. Attitudes were discovered to be positive with regard to the establishment of such a center. Areas of research that were of especial interest were alternative cooling means, energy optimization, automation and control, dynamic dimensioning, theoretical models for projecting and construction, freezing needs for optimal food production and storage, cooling principles and design of cooling units with the aim of optimizing food quality. (AB).

**34402** (NEI-FI-149) **Saving of electricity by controlling electrical equipment in the pulp and paper industry.** Suutela, J. (Jaakko Poeyry Oy, Helsinki (Finland)); Kupari, S. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1990. 49p. (In Finnish). Project KTM-385/881/85. Order Number DE92704031. Source: OSTI; NTIS (US Sales Only).

The possibilities of controlling electrical equipment was surveyed in one pulp mill and one paper mill. The controlling measures are often such that they cannot be handled separately from the process itself. That is why this study also covers some process changes. The criterion for controlling was a pay-back period of less than five years. The saving achieved by controlling electrical equipment in the pulp industry is estimated to be 25 kWh/ton of pulp, which with Finnish pulp production (sulphate + sulphite) of 5 205 000 tons in 1988 is equal to 130 GWh a year. Savings achieved by process changes are estimated to be 70 kWh/ton of pulp, which is equal to 360 GWh a year. The saving achieved by controlling electrical equipment in the paper industry is estimated to be 30 kWh/ton of paper, which with Finnish paper production of 8 653 000 tons in 1988 is equal to 260 GWh a year. Savings achieved by process changes are estimated to be 57 kWh/ton of paper equal to 490 GWh a year. The biggest single saving potential can be found in pumping systems where one pump delivers liquid to many user points. In this case the pumping head is determined by the biggest pressure and the flow by the instantaneous high demand in the system. By replacing one pump in these cases with two or more and by letting the pumps start from the information of a break in a pulp or paper drying machine, a saving which has a pay-back time of less than 2 years can be achieved. The fans of a pulp or paper drying machine can be controlled by the exhaust air moisture, which saves both electricity and drying steam. The examples of this study can be of use when trying to find electricity saving potential in other mills.

**34403** (PNL-7807) **Preliminary economic evaluation of the Alkox process.** Silva, L.J.; Lilga, M.A.; Camaioni, D.M.; Snowden, L.J. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000163. Source: OSTI; NTIS; GPO Dep.

A new chemical process has been invented at Battelle Pacific Northwest Laboratories for converting alkanes to alcohols. This new chemistry has been named the "Alkox Process." Pacific Northwest Laboratory prepared a preliminary economic analysis for converting cyclohexane to cyclohexanol, which may be one of the most attractive applications of the Alkox process. A process flow scheme and a material balance were prepared to support rough equipment sizing and costing. The results from the economic analysis are presented in the non-proprietary section of this report. The process details, including the flow diagram and material balance, are contained in separate section of this report that is proprietary to Battelle. 7 refs., 4 tabs.

**34404** (PNL-SA-19624) **Targeting industrial waste reduction.** Young, J.K.; Grover, S. Pacific Northwest Lab., Richland, WA (United States). Aug 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9108163-1: 2. pollution prevention conference, Pittsburg, PA (United States), 20-21 Aug 1991). Order Number DE91018221. Source: OSTI; NTIS; GPO Dep.

This study wad undertaken for the Advanced Industrial Concepts (AIC) Division of the Office of Industrial Technologies (OIT) of the US Department of Energy (DOE). Review of literature, in-house data, and Toxics Release Inventory (TRI) are used to characterize industrial waste generators and identify the unit operations generating the most waste. What types of processes generate the most industrial emissions? This question is difficult to answer given the limited information that is publicly available. However, we have attempted to gain some insights through literature review, use of in-house data, and analysis of the TRI data. This paper summarizes our findings. 1 ref.

**34405** (SAND-91-1894C) **Low volatile organic compound paints.** Martinez, F.E. Sandia National Labs., Albuquerque, NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109274-1: ECM '91 congress, Santa Fe, NM (United States), 18-20 Sep 1991). Order Number DE91017984. Source: OSTI; NTIS; GPO Dep.

Increasingly stringent air emission standards in various states has dictated the elimination of engineering finishes which are derived from high volatile organic compound (VOC) paint chemistries. In July 1989, Allied-Signal, Inc., Kansas City Division, Kansas City, Missouri, voluntarily closed its paint facility, due to non-compliance with local air emission standards. The following details the materials selection and evaluations which led to current processing using low VOC paints, which permitted the Allied Signal, Inc., paint facility to achieve compliance and resume operations. 1 tab.

**34406** (SAND-91-1940C) **Automated edge finishing using an active XY table.** Starr, G.P. (New Mexico Univ., Albuquerque, NM (United States). Dept. of Mechanical Engineering); Loucks, C.S. Sandia National Labs., Albuquerque, NM (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109259-3: 1. international congress on environmentally conscious manufacturing, Santa Fe, NM (United States), 18 Sep 1991). Order Number DE91019056. Source: OSTI; NTIS; GPO Dep.

Edge finishing and deburring of parts is a tedious operation that should be automated. This paper describes the use of direct-drive XY table in the automated edge finishing of machined parts. The table is faster and more accurate than an articulated robot, thus where planar motion in a small work area is sufficient it is preferable. Hybrid force/position control is used to guide the table (with mounted workpiece) past the tool and maintain the contact force at the desired level. A six-axis force sensor on the tool spindle is used to measure contact force. We identified a dynamic model for the table from experimental measurements and used this model to design a force/position controller for the table. An example application of the table in the deburring of an actual jet engine turbine hub is presented. 5 refs., 12 figs.

**34407** (Y/TR-91/16) **Method of processing alkaline fluoride liquid waste which contains metal ions and oil.** Nishimoto, Takashi; Sasaki, Takashi; Sugisawa, Masanobu. Oak Ridge Y-12 Plant, TN (United States). 1991. 13p. Translation of Japanese Patent Application No. 01-130783, May 23, 1989. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91017791. Source: OSTI; NTIS; GPO Dep.

Alkaline fluoride liquid waste containing metal ions and oil is neutralized by addition of hydrogen fluoride, and then oil is removed; metal ions are absorbed and removed using chelate resin, and then the liquid waste is separated into alkali and hydrogen fluoride, and regenerated and recovered by an ion-exchange membrane electrodialyzer which consists of bipolar membranes, anion exchange membranes and cation exchange membranes. The hydrogen fluoride which is added to the above liquid part of the recovered hydrogen fluoride. 2 figs.

**34408** (Y/TR-91/20) **Recovery of hydrofluoric acid.** Sato, Kimiyasu (Tosoh Corp., Yamaguchi (Japan)); Kurauchi, Yasuhiro;

Miyagi. Yoshiyuki: Akazawa, Michihiro. Oak Ridge Y-12 Plant, TN (United States). [1991]. 8p. Translation of Japanese Patent Application 1989-123606, November 5, 1987, publication date May 16, 1989. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91018435. Source: OSTI; NTIS; GPO Dep.

The invention relates to recovery, and regeneration, of hydrofluoric acid by means of electrodialysis, with a goal of utilizing resources effectively and avoiding pollution. The recovery method for hydrofluoric acid is characterized by an electrodialysis apparatus that consists of one or more units made up of anode chamber, a cathode chamber and a central divided chamber, where the anode chamber and the central divided chamber come into contact through the anion exchange membrane; the central divided chamber, beginning with the anode chamber, is composed of a recovery chamber, cation exchange membrane, feed chamber, and anion exchange membrane; the fundamental structure of the electrodialysis cell consists of a central divided chamber and an anion exchange membrane in a unit on the side of the cathode chamber. 3 figs.

## 3206 Municipalities and Community Systems

*Refer also to citation(s) 33867, 34347*

**34409** (BNL–46477) **Treatment of municipal solid waste (MSW) by the hydrocarb process.** Steinberg, M. Brookhaven National Lab., Upton, NY (United States). May 1991. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-910812–12: 202. national meeting of the American Chemical Society (ACS), New York, NY (United States), 25-30 Aug 1991). Order Number DE91016996. Source: OSTI; NTIS; GPO Dep.

Application of the hydrocarb process to management of municipal solid waste is described. The economics of a waste processing plant is discussed. 2 refs., 1 tab. (CBS)

**34410** (CONF-9110216–1) **Estimated increases in the cost of electricity under three acid-rain control bills.** Hillsman, E.L. (Oak Ridge National Lab., TN (United States)); Alvic, D.R. Oak Ridge National Lab., TN (United States). [1991]. 19p. Sponsored by USDOE, Washington, DC (United States); Department of the Interior, Washington, DC (United States). DOE Contract AC05-84OR21400. From 1991 applied geography conference; Toledo, OH (United States); 23-27 Oct 1991. Order Number DE92000049. Source: OSTI; NTIS; GPO Dep.

Several bills were introduced in the past two Congresses to reduce emissions of sulfur dioxide and nitrogen oxides from electric power plants. The effects of these bills on electricity costs depend on features of the bills, on the mix of generating capacity owned by different electric utilities, on the technologies available for complying with the legislation, and on the time horizon used to calculate the costs. A system of computer software has been developed to make utility-specific estimates of the effects of different legislation on electricity costs. This paper presents sample results from a larger analysis of six pieces of legislation. These results suggest that the emissions trading systems proposed in some legislation, and adopted in the Clean Air Act Amendments of 1991, may have less effect than expected on the cost of complying with the legislation. 5 refs., 2 figs., 2 tabs.

**34411** (LBL–29642) **Stimulating utilities to promote energy efficiency: Process evaluation of Madison Gas and Electric's Competition Pilot Program.** Vine, E.; De Buen, O.; Goldfman, C. Lawrence Berkeley Lab., CA (United States). Dec 1990. 178p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000603. Source: OSTI; NTIS; GPO Dep.

This report describes the process evaluation of the design and implementation of the Energy Conservation Competition Pilot (hereafter referred to as the Competition), ordered by the Public Service Commission of Wisconsin (PSCW) with a conceptual framework defined by PSCW staff for the Madison Gas and Electric (MGE) Company. This process evaluation documents the history of the Competition, describing the marketing strategies adopted by MGE and its competitors, customer service and satisfaction, administrative issues, the distribution of installed measures, free riders, and the impact of the Competition on MGE, its competitors, and other Wisconsin utilities. We also suggest recommendations for a future Competition, compare the Competition with other approaches that public utility commissions (PUCs) have used to motivate utilities to promote energy efficiency, and discuss its transferability to other utilities. 48 refs., 8 figs., 40 tabs.

**34412** (NEI-DK–618) **Jaegerspris energy.** Plan og Projekt A/S. Aabyhoej (Denmark). Jan 1991 49p. (In Danish). Contract ENS-51121-0021. Order Number DE92703792. Source: OSTI; NTIS (US Sales Only).

The energy supply and energy consumption in the municipality of Jaegerspris, Denmark has been evaluated with the purpose of establishing a district heating system based on local energy and renewable energy sources and to define the potentials for energy conservation in the area. Further more the aim was to minimize the energy losses, to ensure a decrease in energy consumption, and to reduce the environmental effects of energy production and energy consumption, without further expenses for the consumers. It is shown that by establishing district heating, and encouraging consumers to save energy the aim will be fulfilled. (CLS).

**34413** (NEI-DK–619) **Jaegerspris energy: Supplement.** Plan og Projekt A/S. Aabyhoej (Denmark). Jan 1991 46p. (In Danish). Contract ENS-51121-0021. Order Number DE92703793. Source: OSTI; NTIS (US Sales Only).

The technical details of a district heating system with a straw-fired power plant and a wood-chip-fueled power plant, a solar heating system and wind turbines are described. As well as the district heating network, installations at consumption points, details of the power plants and wind turbine siting are dealt with. Maps illustrating the siting of power plants and of wind turbines, the district heating network and the geographical area are included. Calculations on alternative projects are presented. (CLS).

**34414** (NEI-DK–626) **LOCUS- or cogeneration plant for Langholt.** Rosager, F. Landsbyenergi A/S, Vodskov (Denmark). Jun 1991 106p. (In Danish). Contract ENS-51121-9047. Order Number DE92703865. Source: OSTI; NTIS (US Sales Only).

Covertitel: Langholt LOCUSanlaeg.

The project aims at determining the technology and considering the economy of establishing district heating supply in a local rural area, which is to be based on a cogeneration plant. Environmental protection is a priority. The choice of design and components is described in detail. (AB).

**34415** (NEI-DK–628) **Measuring programme carried out on accumulation tanks.** Plan og Projekt A/S, Aabyhoej (Denmark). Jul 1991 39p. (In Danish). Contract ENS-51121-9042. Order Number DE92703866. Source: OSTI; NTIS (US Sales Only).

The aim was to investigate the feasibility of establishing accumulator tanks in four Danish straw-fuelled district heating plants. The technological, operational end economical consequences are dwelt upon. The resulting measurements, mostly in the form of graphs, and recommendations are presented. It is concluded that installing an accumulator tank would contribute to the saving of fuel (in this case straw) especially where the boiler efficiency was low. Money could also be saved, but the amount may not cover initial investments. (AB).

**34416** (NEI-DK–629) **Measuring programme carried out on accumulation tanks: Supplement.** Plan og Projekt A/S, Aabyhoej (Denmark). Jul 1991 80p. (In Danish). Order Number DE92703867. Source: OSTI; NTIS (US Sales Only).

Measured data from the project "Measuring program carried out on accumulator tanks" (the aim of which was to investigate the feasibility of installing such tanks in relation to straw-fuelled district heating plants) in the form of a supplement. (AB).

**34417** (NEI-DK–641) **Testing of ER-unit with wood fuelling: Documentation and measurements from the pilot system Sdr. Felding.** Evald, A. Skovteknisk Inst., Copenhagen (Denmark). Jun 1991 78p. (In Danish). Contract TR-88.1084. Order Number DE92703894. Source: OSTI; NTIS (US Sales Only).

The results of performance testing and measurements on a commercially produced unit the aim of which is to recover heat from flue gas found in a wood fuelled district heating plant. The unit is installated in the smoke outlet found in connection with the boiler. Here the smoke is cooled and its steam content is condensed. A characteristic of the unit is that the smoke is cooled down to the same temperature as the inlet air, at the same time the inlet air is dampened so that it then contains energy. It is claimed that the use of this patented unit results in a larger extent of energy utilization than more conventional systems for flue gas cooling (AB).

**34418** (NEI-DK–643) **Low temperature in practice: District heating.** Plan og Projekt A/S, Aabyhoej (Denmark). Jul 1991 42p. (In Danish). Contract ENS-51121-9027. Order Number DE92703896. Source: OSTI; NTIS (US Sales Only).

Low temperature district heating reduces heat losses in the distribution network, and thus contributes to energy conservation. Two Danish district heating plants and consumer installations were closely examined with the aim of advising the owners as to the potentials and advantages of low temperature operation. Consumers generally fear that with this type of operation their domestic hot water will only be luke warm. Results of investigations are presented, economic aspects are also dealt with. (AB).

# 33 ADVANCED PROPULSION SYSTEMS

*Refer also to citation(s) 34353*

**34419** (LA-UR–91-2800) **Experimental measurements in a radio frequency discharge heated supersonic flow: Evaluation of a potential electric propulsion thruster.** Wantuck, P.J.; Hull, D.E. Los Alamos National Lab., NM (United States). [1991]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109226–12: AIAA/NASA/OAI conference on advanced SEI technologies, Cleveland, OH (United States), 3-4 Sep 1991). Order Number DE91018007. Source: OSTI; NTIS; GPO Dep.

An operational radio frequency discharge-driven supersonic flow system, which utilizes an inductively and capacitively coupled plasma (ICCP) tube to produce high enthalpy source gas, is described. The ICCP coupled to a properly designed nozzle represents a potential electric propulsion device. The high gas temperatures achieved in the plasma discharge (> 5000 K) and the electrodeless nature of the tube's operation offers potentially high thruster performance coupled and long operational lifetime. A preliminary characterization of the current system was established using emission and probe-based measurements. A nominal peak specific impulse of 155 s was estimated for operation with argon. The calculated thrust based upon the peak velocity and mass flow through the device is 1.1 N. 14 refs., 10 figs.

## 3301 Internal Combustion Engines

*Refer also to citation(s) 33925, 34426*

**34420** (CONF-910617–5) **Material and lubricant relationships in the tribology of internal combustion engines.** Yust, C.S. Oak Ridge National Lab., TN (United States). [1991]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 4. international symposium on ceramic materials and components for engines; Goeteborg (Sweden); 10-12 Jun 1991. Order Number DE92000674. Source: OSTI; NTIS; GPO Dep.

Ceramics are being introduced into production engines for both wear resistance and inertial response, as well as for thermal barrier and elevated temperature capability. The selection of both materials and lubricants for future generations of engines will be influenced by the demands for efficient, environmentally sound, and minimally serviced but long-lived operation. The long-term tribological response of the selected materials is a significant issue which does not generally receive sufficient attention. An experimental approach to the evaluation of the long-term response of engine candidate ceramics, based on an earlier wear mode transition diagram, is discussed in this paper. Data are presented for initial studies of a silicon carbide whisker-silicon nitride composite. 22 refs., 7 figs., 1 tab.

**34421** (NAL-TR–1080) **Experiment on ignition in a rectangular cross section scramjet combustor.** Kudo, K. (National Aerospace Laboratory, Tokyo (Japan)); Komuro, T.; Masuya, G.; Murakami, A.; Tani, K.; Wakamatsu, Y.; Kanda, T.; Chinzei, N. National Aerospace Lab., Chofu, Tokyo (Japan). Sep 1990. 15p. (In Japanese). Order Number DE92709529. Source: OSTI; NTIS (US Sales Only).

In order to investigate ignition characteristics in a scramjet combustor expected to a space shuttle, an experiment on autoignition and plasma-torch forced-ignition of hydrogen fuel were carried out using a supersonic combustor with rectangular cross sections and steps. The following conclusions were obtained. Ignition behavior fell into three distinct categories, separated by the three bounding curves on an air temperature-fuel flow rate plane. Compared with injection from a single orifice, injection from multiple orifices appreciably enhanced autoignition, because fuel jets from adjacent orifices and from those on the opposite wall tended to attenuate the local flame quenching. A newly developed plasma torch with an operating gas of air or oxygen stably operated without argon as a support gas. It was shown that the effectiveness of an air or oxygen plasma torch was comparable to that of a nitrogen or argon-hydrogen plasma torch, with exception of an argon-hydrogen plasma torch in single-wall injection. 8 refs., 15 figs., 2 tabs.

**34422** (NEI-DK–631) **Analysis of small gas turbines - and turbine driven power plants.** Hiltunen, J. (Neste OY (FI)); Holopainen, O.; Nikkonen, J.; Stoor, H. Nordisk Gasteknisk Center, Hoersholm (Denmark). Feb 1991 39p. (In Swedish). Order Number DE92703869. Source: OSTI; NTIS (US Sales Only).

The object of the project was to assess market potential, technology and economical feasibility of small gas engine and turbine driven power plants in Finland. The power range was 0,5...10 MWe. Equipment suppliers were asked to submit their solution which were then reviewed regarding to the technical properties and emission values. Competitiveness of the different power packages were evaluated especially between engine and turbine. As a result of the study we can say that gas engine/turbine is competitive if power and heat from the engine and flue gas cooling can be utilized for the most part. Price of the electricity used was the same as the whole sale price for the medium sized industry. Investment has to be realized cost effectively and plant service has to be organized well. Already one of these factors can spoil the profitability of the plant. The most important factor effecting to the internal rate of return is the price of the electricity; the effect of the gas price and the investment cost is smaller than the half of the price of the electricity. Profitability of the power plant could be increased if a part of the power produced could be sold to the utility with the price of the purchased power. (author).

**34423** **Methane methanol generating system for internal combustion engines.** McBurney, J.B. 9 May 1991. Filed date 9 Nov 1989. Canada Patent patent application 2002575. 8p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

In an improved carburation process for an internal combustion engine, gasoline droplets are vaporized before they enter the engine cylinders. The gasoline vapor is mixed with water vapor and the resulting mixture is converted over a catalyst into a mixture of low molecular weight hydrocarbons, methane, and methanol. This mixture is mixed with air and is drawn into the engine cylinders where it is exploded to provide motive power more efficiently than in a conventionally carburetted engine. The gaseous products of combustion in the improved process give a lower contribution to atmospheric pollution than the products from conventional gasoline engines. Apparatus for carrying out the process of the invention includes an injector for gasoline droplets, a heater heated by hot exhaust gases and associated control devices, and a precarburation system consisting of a series of tubings and a heated catalyst bed. 3 figs.

**34424** **Diesel engine fuel pipeline heating device.** Huang, Kuo-Liang. 23 Apr 1991. Filed date 23 Oct 1989. Canada Patent

patent application 2001218. 7p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2. Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A diesel engine fuel pipeline heating device is provided which promotes full fuel combustion, enables easy and smooth starting and running of the engine, saves fuel, and enhances the horsepower of the engine. The device of the invention consists of an electric heater and a water (or air) heater provided to the exterior of a diesel engine fuel pipe. A diesel engine equipped with the device of the invention can be easily started by using the electric heater to heat the fuel in the fuel pipe up to a suitable starting temperature of ca 40°C before starting the engine. After the engine has run for sufficient time so that the temperature in the heating cylinder of the water (or air) heater has risen to the suitable combustion temperature already mentioned, the power to the electric heater can be automatically turned off to stop the heating action. Subsequently, the hot water from the water return pipe of the radiator or the hot air from the exhaust pipeline of the exhaust pipe continues to preheat the fuel pipe through the water (or air) heater so as to keep the fuel at a suitable combustion temperature. 3 figs.

## 3302 External Combustion Engines

**34425** (NAL-TR–1090) **Axial thrust balancing for small high-speed high-pressure rocket pumps.** Shimura, T. (National Aerospace Laboratory, Tokyo (Japan)); Watanabe, M.; Hasegawa, S. National Aerospace Lab., Chofu, Tokyo (Japan). Dec 1990. 13p. (In Japanese). Order Number DE92709533. Source: OSTI; NTIS (US Sales Only).

In order to comprehend an axial thrust balancing system of a rocket pump under severe operating conditions, characteristics and feasibility of a self-balancing type axial thrust balancing system, refferred to as "balance pisto", for a high-pressure cryogenic rocket pump were studied. Two small rocket pumps. one of which was a single-stage liquid oxygen pump with an inducer and the other was a two-stage liquid hydrogen pump with an inducer, were tested under various operating conditions. Investigation items were as follows; the effects of the pump flow rate, flow rate through the balancing chamber, and pump rotational speed on the balance piston characteristics. Transient characteristics of the balance piston were also investigated. As a result, it was concluded that the balance piston was able to adjust wide range of axial thrust change due to variation of operating conditions and was feasible for high-speed, high-pressure, cryogenic rocket pumps although special attention to transient characteristics was necessary. 9 refs., 16 figs., 2 tabs.

## 3303 Electric-Powered Systems

*Refer also to citation(s) 34214, 34223, 34360, 34426*

## 3304 Hybrid Systems

**34426 Computer controlled optimized hybrid engine.** Kos, J.F. 27 Apr 1991. Filed date 27 Oct 1989. Canada Patent patent application 2001712. 52p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

New and useful improvements are disclosed for internal combustion engines, providing the basis of a systems approach to optimize engine reliability, efficiency, pollution control, versatility, manufacturing costs, and operating costs. The invention is a hybrid engine employing a reciprocating piston in conjunction with an electromagnetic transducer for control and power output. The transducer is essentially a specialized linear motor/generator. The piston is rigidly connected by means of a rod to a permanent magnet or equivalent. The piston-rod-magnet unit is constrained by bearings to move translationally along one axis. The magnet can move linearly into and out of the yoke of the magnetic transducer to generate an electric current in the windings of the yoke. At the same time, computer control of the effective impedances of these windings as well as computer controlled currents provided by an electric storage battery or electrical energy storage indicator flowing through some or all of the windings control the motion of the magnet and hence of the piston. Computer control is also exercised over other devices to regulate such parameters as ignition timing, fuel injection, air intake, and valve motion. The power output may be used to drive ac, dc, or ac/dc motors or it may be wholly or partially rectified to charge batteries and/or power ac/dc or dc motors or to power other devices. 4 figs.

## 3306 Vehicle Design Factors

**34427** (LA-UR–91-2473) **Four-wheel-drive powertrain models for real-time simulation.** Freeman, J.S. (Los Alamos National Lab., NM (United States)); Velinsky, S.A. Los Alamos National Lab., NM (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-911213–5: American Society of Mechanical Engineers (ASME) annual winter meeting, Atlanta, GA (United States), 1-6 Dec 1991). Order Number DE91016232. Source: OSTI; NTIS; GPO Dep.

Dynamic vehicle powertrain models have been formulated by many researchers for particular applications, mainly the analysis of powertrain characteristics or vibration. In this paper, we formulate models of four-wheel-drive vehicle powertrains for the purpose of real-time simulation. While not encompassing the complete characteristics of powertrain operation, these models are applicable for use in vehicle simulators. and include both the differential and lock-up modes of four-wheel-drive transfer case operation. The models of four-wheel-drive powertrains are applied to a particular vehicle, the US Army High Mobility Multipurpose Wheeled Vehicle or HMMWV, in order to compare and contrast both the simulated vehicle performance and the computational complexity of the models. The HMMWV powertrain incorporates a wide variety of components including: automatic transmission, torque converter, worm-gear differentials, transfer case for both differential and lock-up operation, and final-drive speed reducers at the wheel hubs. Thus the simulation of this vehicle indicates the wide application of the developed models. 9 refs.

# 35 ARMS CONTROL

## 3501 Policy, Negotiations, and Legislation

*Refer also to citation(s) 34985, 34986*

## 3503 Verification

*Refer also to citation(s) 34982, 34987*

# 36 MATERIALS

*Refer also to citation(s) 35482*

**34428** (INIS-SU–273/A) **Radiation materials science. V. 2.** AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990 251p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers are processed separately for the data base.

## 3601 Metals and Alloys

*Refer also to citation(s) 33618, 33844, 33965, 33968, 33969, 33973, 33974, 33987, 33990, 34021, 34022, 34025, 34039, 34281, 34289, 34374, 34609, 34792, 34799, 34804, 34834, 34835, 34838, 34846, 34853, 34967, 34974, 35183, 35341, 35350, 35434, 35469*

**34429** (CONF-8906112–, pp. 41-48) **Experimental measurements of CTOD corresponding to crack initiation.** Reuter, W.G., Graham, S.M. (Idaho National Engineering Lab., Idaho Falls (USA)); Lloyd, R.W. Argonne National Lab., IL (United States). [1989]. DOE Contract AC07-76ID01570. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21

Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Fracture mechanics data are used to predict structural integrity because it is too expensive to test structural components under realistic conditions. One of the objectives of this program is to compare data from specimens containing surface cracks, which simulate structural components, with data from standard fracture toughness specimens to evaluate how well the standard data predict initiation of crack growth for the surface cracked specimens in the nonlinear elastic fracture mechanics regime. Recent work has dealt with how to define crack initiation and how to accurately and efficiently measure crack-tip opening displacement. This paper describes a methodology for obtaining the desired data.

**34430** (CONF-8906112–, pp. 49-53) **Slowness surfaces and interfacial waves in anisotropic elastic solids.** Barnett, D.M. (Stanford Univ., CA (USA)). Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

The theory of surface (Rayleigh) and interfacial (Stoneley and slip or Murty) waves in linear anisotropic elastic solids has recently become quite well-developed. As it turns out the question of existence of such modes and their speeds of propagation is settled virtually solely by considering the state of affairs existing at the so-called limiting speed or first transonic state. This state is most easily described in terms of slowness sections (slices through three-dimensional slowness surfaces). The present paper reviews the present state of affairs in surface and interfacial wave theory, and points out how computer graphics can be used to look for directions in anisotropic crystals in which interesting wave phenomena occur.

**34431** (CONF-8906112–, pp. 79-84) **Sheath dynamics and stochastic heating in R.F. discharges.** Lieberman, M.A. (Univ. of California, Berkeley (USA)). Argonne National Lab., IL (United States). [1989]. DOE Contract FG03-87ER13727. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Low pressure r.f. discharges are widely used for materials processing. Typical parameters are pressure 1-100 mTorr, frequency 13.56 mHz, and r.f. voltage 50-1,000 V. Almost all the applied voltage is dropped across capacitive sheaths at the discharge electrodes or wall surfaces. Hence, the sheaths control the power deposition in the discharge. A reasonably complete picture of the dynamics of these sheaths has been developed. In this work, the author reviews what is known, drawing from analyses, experiments, and computer simulations by himself and others, as appropriate. Topics that are described include sheath thickness, capacitance and conductance, d.c. bias and harmonic voltage generation, stochastic heating byt the oscillating sheath, and the effects of low r.f. driving voltage, time-average electron space charge, and ion collisions within the sheath. Applications to non-symmetric discharges, having electrodes with unequal areas, are described.

**34432** (CONF-9105254–1) **Creep response of a 9Cr-1Mo-V-Nb steel to varying stresses and temperatures.** Swindeman, R.W. Oak Ridge National Lab., TN (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 7. international conference on pressure vessel technology (ICPVT); Dusseldorf (Germany); 31 May - 5 jun 1991. Order Number DE91017871. Source: OSTI; NTIS; GPO Dep.

Deformation data were collected on specimens from a plate of a 9Cr-1Mo-V-Nb steel (SA 387 Grade 91) tested under constant and variable load conditions to 10,000 h. Data included results from relaxation, step-stress creep, cyclic creep, and a few nonisothermal tests. Ignoring short time transient effects, the use of a simple creep law in combination with the strain-hardening rule produced a reasonable correlation between observed and calculated creep rates for a variety of non-steady conditions in the primary and secondary creep regimes. 12 refs. 8 figs.

**34433** (CONF-9106275–1) **Moisture-induced environmental embrittlement of ordered intermetallic alloys at ambient temperatures.** Liu, C.T. Oak Ridge National Lab., TN (United States). 30 Aug 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From NATO advanced research workshop; Irsee (Germany); 23-29 Jun 1991. Order Number DE91018852. Source: OSTI; NTIS; GPO Dep.

Recent studies have demonstrated that moisture-induced environmental embrittlement is a major cause of low ductility and brittle fracture in ordered intermetallics with high crystal symmetries (e.g. $L1_2$ and B2). The embrittlement involves the reaction of reactive elements in intermetallics with moisture in air and the generation of atomic hydrogen at crack tips. The loss in ductility at ambient temperatures is generally accompanied by a change in fracture mode from ductile appearance to brittle grain-boundary fracture in many $L1_2$ intermetallics, and to brittle cleavage in body-centered cubic (bcc)-ordered intermetallics. In a number of cases, the embrittlement was alleviated by alloy design through control of microstructure and alloy composition. 56 refs., 6 figs., 5 tabs.

**34434** (CONF-9106275–2) **Creep in $L1_2$-intermetallics.** Schneibel, J.H. (Oak Ridge National Lab., TN (United States)); Hazzledine, P.M. Oak Ridge National Lab., TN (United States). [1991]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From NATO advanced research workshop; Irsee (Germany); 23-29 Jun 1991. Order Number DE91018231. Source: OSTI; NTIS; GPO Dep.

Several intermetallic compounds with the $L1_2$-structure exhibit a yield strength anomaly (YSA), i.e., the yield stress increases as the temperature increases. As shown for $Ni_3Al$, no corresponding "creep strength anomaly" exists. The creep strength decreases in a normal manner with increasing temperature. Its orientation dependence is different from that observed in the YSA regime. The transient creep of $Ni_3Al$ is composed of a normal ("work hardening") and an inverse ("work softening") part. The reasons for such transients are discussed. Specific models for the dependence of strain rate vs. strain during inverse creep as well as for the orientation dependence of the creep strength are reviewed and compared with experiments. Experiments and models indicate that the strain rate $\dot{\varepsilon}$ depends on the strain $\varepsilon$ approximately as $\varepsilon$ or $\varepsilon^{2/3}$. The orientation dependence of the creep strength is particularly pronounced at low temperatures and changes at high temperatures and low stresses. At low creep stresses, $Ni_3Al$ is not as strong as high-strength superalloys, due to its low stress exponent. However, further optimization may be possible. As to the creep of other $L1_2$-compounds, very little information is available and no distinct evidence for inverse creep has been found. This may be due to the lower yield stresses and less pronounced YSA in these compounds.

**34435** (CONF-910938–3) **The effect of casting temperature on the fatigue properties of cast nickel aluminide alloys.** Gieseke, B.; Sikka, V.K. Oak Ridge National Lab., TN (United States). [1991]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International conference on high temperature aluminides and intermetallics; San Diego, CA (United States); 17-19 Sep 1991. Order Number DE92000432. Source: OSTI; NTIS; GPO Dep.

The results of high cycle fatigue tests at 650°C on several cast $Ni_3Al$ alloys are reported and compared to cast IN-713C. These alloys include IC-221M and several variations to the IC-221M composition. The effect of casting temperature is investigated using castings poured at three different temperatures spanning a 56°C range. The results show that IC-221M cast at the highest temperature has the best fatigue strength, exceeding that for IN-713C. In these alloys, crack initiation occurs at shrinkage microporosity and the effect of casting temperature on porosity is related to the observed differences in fatigue lives. 11 refs., 4 figs.

**34436** (CONF-9109281–1) **Primary fabrication processes for nickel and iron aluminides.** Weir, J.R. Jr.; Sikka, V.K. Oak Ridge National Lab., TN (United States). [1991]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Aerotech '91 Society of Automotive Engineers

(SAE) conference; Long Beach, CA (United States); 23 Sep 1991. Order Number DE91018855. Source: OSTI; NTIS; GPO Dep.

Alloys based on the intermetallic compounds $Ni_3Al$ and $Fe_3Al$ have been developed. Intermetallic compounds are characteristically brittle at room temperature, and some are also brittle at elevated temperatures. Nickel-aluminide alloys have been made ductile by alloying with a small amount of boron (200 ppm by weight) and adjusting the aluminum content to 24 at. % or less. Iron-aluminide alloys are ductile when chromium is added (>wt 2%) and the aluminum is adjusted to 28 at %. These alloys begin ordering upon solidification; therefore, a greater shrinkage must be accommodated during casting. The hot-working temperature "window" for the nickel-aluminide alloy is very narrow; however, the alloy can be cold-worked large amounts. Iron-aluminide alloys have a very broad hot-working temperature range but have limited ductility (<20%) at room temperature. The strength and oxidation resistance of these alloys are such that many potential applications exist. Commercialization is in progress. 15 refs., 14 figs., 2 tabs.

**34437** (CONF-9109286–2) **Effects of ambient background gases on YBCO plume propagation under film growth conditions: Spectroscopic, ion probe, and fast photographic studies.** Geohegan, D.B. Oak Ridge National Lab., TN (United States). Sep 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From European Materials Research Society (E-MRS) summer school on laser ablation of electronic materials: basic mechanisms and applications; Carcans-Maubuisson (France); 16-19 Sep 1991. Order Number DE92000431. Source: OSTI; NTIS; INIS; GPO Dep.

The formation, composition, and propagation of KrF laser-produced plasmas from $Y_1Ba_2Cu_3O_{7-x}$ have been studied with emphasis on topics relevant to film growth by pulsed-laser deposition. Spatially and temporally resolved, high-resolution optical absorption and emission spectroscopy, fast ion probes, and fast photography [obtained with a gated, image-intensified CCD array detector (ICCD)] are employed to investigate both emitting and non-emitting species in the laser plume as well as the overall shape and propagation of the laser plasma in background gases of oxygen and xenon. Transient optical absorption spectroscopy is applied to study the composition of the plume of ejected material from the dense layer near the target surface to distances of several centimeters. Optical absorption persists long after the decay of plasma fluorescence, indicating a slower component to plume transport. The absorption of YO formed by YBCO ablation in vacuum and by-yttrium ablation in oxygen is presented. Fast electric ion probes are utilized to measure velocities and total collected charge of the positive ions in the expanding YBCO laser plasma from near-threshold, vacuum conditions into the high fluence, background gas conditions utilized for thin-film growth. The exponential attenuation of the positive ion flux transmitted through 50–300 mTorr background oxygen is measured and used to define an attenuation coefficient. The showing of the laser plasma and formation of shock structures due to gas collisions is studied by ion probe measurements and fast ICCD photography. A comparison between shock wave propagation and drag models is presented to describe the arrival time and shape of the ion probe current waveform with distance. 11 refs, 11 figs.

**34438** (CONF-911048–1) **Propagation behavior of small cracks in 304 stainless steel under biaxial low-cycle fatigue at elevated temperature.** Ogata, Takashi (Central Research Inst. of Electric Power Industry, Tokyo (Japan)); Nitta, Akito; Blass, J.J. Oak Ridge National Lab., TN (United States). [1991]. 26p. Sponsored by Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC05-84OR21400. From American Society for Testing and Materials (ASTM) symposium on thermo-mechanical fatigue: behavior of materials; San Diego, CA (United States); 14-17 Oct 1991. Order Number DE91018863. Source: OSTI; NTIS; GPO Dep.

To investigate the propagation behavior of small cracks and the relationship between crack propagation and fatigue life, strain- controlled in-phase and 90°-out-of-phase axial-torsional fatigue tests were conducted at 550°C using tubular specimens of 304 stainless steel with and without surface notches. During the tests, observations of crack initiation and propagation were frequently made using replica films and an optical microscope. Most of the fatigue life was spent in the propagation of small cracks less than 2 mm long. Regardless of loading conditions, the crack propagation rate correlated well with the equivalent shear strain range defined as a function of maximum shear strain range and normal strain range on the plane of the maximum shear strain range. The biaxial low-cycle fatigue life could be estimated from the relationship between the crack propagation rate and the equivalent shear strain range. 10 refs., 10 figs.

**34439** (CONF-911048–2) **A method for multiaxial fatigue life prediction using energy approaches.** Liu, K.C. Oak Ridge National Lab., TN (United States). [1991]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Society for Testing and Materials (ASTM) symposium on thermo-mechanical fatigue: behavior of materials; San Diego, CA (United States); 14-17 Oct 1991. Order Number DE91018851. Source: OSTI; NTIS; GPO Dep.

Fatigue criteria based on the concept of damage energy have been proposed and evaluated with experimental fatigue data generated under uniaxial as well as biaxial loading conditions. Most of the energy-based methods utilize plastic energy of stress-strain hysteresis loops as a correlating parameter. Limited success has been made in predicting fatigue life in the low-cycle fatigue range where the plastic energy of the hysteresis loops is well defined. However, is is difficult to estimate the plastic hysteresis energy in the high-cycle range where the stress-strain behavior is virtually elastic. Failure to adequately predict high-cycle fatigue life is an obvious shortcoming of the plastic energy-based method. A new method is proposed for multiaxial fatigue life prediction using strain energy as a correlating parameter which is physically associated with modes of fatigue fracture on a critical plane of the material that may be sensitive to either axial stress or shear at a given temperature. Biaxial fatigue data were analyzed for type 304 stainless steel and SAE 1045 steel subjected to in-phase and 90° out-of-phase tension/torsion loading at room and elevated temperatures. Comparisons were made between the experimental data and theoretical predictions to show the effectiveness to the new energy-based approach.

**34440** (CONF-9110226–1) **Computer modeling of arc welds to predict effects of critical variables on weld penetration.** Zacharia, T.; David, S.A. Oak Ridge National Lab., TN (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 7. annual North American welding research (NAWR) conference; Columbus, OH (United States); 2-4 Oct 1991. Order Number DE92000428. Source: OSTI; NTIS; GPO Dep.

In recent years, there have been several attempts to study the effect of critical variables on welding by computational modeling. It is widely recognized that temperature distributions and weld pool shapes are keys to quality weldments. It would be very useful to obtain relevant information about the thermal cycle experienced by the weld metal, the size and shape of the weld pool, and the local solidification rates, temperature distributions in the heat-affected zone (HAZ), and associated phase transformations. The solution of moving boundary problems, such as weld pool fluid flow and heat transfer, that involve melting and/or solidification is inherently difficult because the location of the solid-liquid interface is not known a priori and must be obtained as a part of the solution. Because of non-linearity of the governing equations, exact analytical solutions can be obtained only for a limited number of idealized cases. Therefore, considerable interest has been directed toward the use of numerical methods to obtain time-dependant solutions for theoretical models that describe the welding process. Numerical methods can be employed to predict the transient development of the weld pool as an integral part of the overall heat transfer conditions. The structure of the model allows each phenomenon to be addressed individually, thereby gaining more insight into their competing interactions. 19 refs., 6 figs., 1 tab.

**34441** (CONF-911196–1) **Rapid solidification effects during laser welding.** David, S.A.; Vitek, J.M. Oak Ridge National Lab., TN (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 10. international congress on applications of lasers and electro-optics

(ICALEO) conference: San Jose, CA (United States); 3-8 Nov 1991. Order Number DE91018934. Source: OSTI; NTIS; GPO Dep.

This report discusses solidification behavior of alloys during laser welding. Microstructure and solidification effects are briefly covered. (JL)

**34442** (CONF-911213–6) **ORNL unified constitutive equations adapted for strain softening and high strain-rate conditions.** Chang, S.J.; Pugh, C.E. Oak Ridge National Lab., TN (United States). [1991]. 25p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) annual winter meeting; Atlanta, GA (United States); 1-6 Dec 1991. Order Number DE91017690. Source: OSTI; NTIS; INIS; GPO Dep.

The unified creep-plasticity constitutive equations developed earlier at the Oak Ridge National Laboratory are modified to model the viscoplastic behavior of A533 grade B class 1 steel under high strain-rate conditions and yield drop at low strain rates. The development is aimed at providing an improved model for use in dynamic fracture analyses. A set of material constants is obtained from test data over the temperature range of −60 to 175°C and strain rate range of $10^{-4}$ to 550 $s^{-1}$. The unified equations were implemented in finite element analyses to calculate the dynamic fracture parameters J and T for some large wide-plate fracture experiments. The results show good agreement with fracture calculations based on other viscoplastic models. Discussion is provided on physical evidence supporting this material model. 35 refs., 7 figs.

**34443** (CONF-911240–2) **Grain boundary fracture and alloy design of intermetallics.** George, E.P.; Liu, C.T. Oak Ridge National Lab., TN (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. Japan international Society for the Advancement of Material and Process Engineering (SAMPE) symposium and exhibition; Chiba (Japan); 11-14 Dec 1991. Order Number DE91018253. Source: OSTI; NTIS; GPO Dep.

This paper reviews recent progress in our understanding of brittle grain-boundary (GB) fracture in ordered intermetallics. Different kinds of GB brittleness are considered, including intrinsic intergranular (IG) brittleness, which in alloys like $Ni_3Al$ is the single major cause of poor ductility and brittle fracture, but in others (like NiAl and FeAl) is not the sole cause. Consequently, although boron suppresses IG fracture in all three intermetallics, it produces dramatic ductilization only in $Ni_3Al$ and not in FeAl or NiAl. Extrinsic GB brittleness is examined by considering $Ni_3Si$, in which environmental embrittlement is a major cause of IG fracture, and the beneficial effect of boron apparently to suppression of that embrittlement. 70 refs., 2 figs., 2 tabs.

**34444** (EGG-M–91290) **Strengthening of an AISI 1020 steel by aluminum-microalloying during liquid dynamic compaction.** Matsuo, S. (Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Materials Science and Engineering); Ando, T.; Zody, M.C.; Grant, N.J. EG and G Idaho, Inc., Idaho Falls, ID (United States); Massachusetts Inst. of Tech., Cambridge, MA (United States). Dept. of Materials Science and Engineering. [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG07-89ID12855. (CONF-9106277–1: 1991 powder metallurgy conference, Pittsburgh, PA (United States), 24-26 Jun 1991). Order Number DE91018745. Source: OSTI; NTIS; GPO Dep.

Grain size refinement was achieved in an AISI 1020 steel alloyed with 0.06 wt. % aluminum by liquid dynamic compaction (LDC), a rapid solidification spray deposition process. Atomization was done with nitrogen which resulted in incorporation of about 0.05 wt. % nitrogen in the spray deposited steel. The spray deposit showed a fine (10–40 $\mu$m), equiaxed ferrite plus pearlite structure and a high as-deposited density of about 95% of theoretical. Minor reductions up to 70% in hot rolling plus annealing, both at low austenitic temperatures (850–900°C), fully densified the deposit and produced significantly finer (3–4 $\mu$m) ferritic grains with uniformly distributed fine pearlite colonies. The grain size refinement resulted from pinning of prior austenitic grain boundaries by fine AlN particles which precipitated during the thermomechanical treatments (TMT). Room temperature yield and ultimate tensile strength values exceeding 80 and 90 ksi (550 and 620 MPa), respectively, were achieved at high ductility levels. The fine microstructures were stabilized by AlN precipitates even on reheating to temperatures up to 1100°C. 19 refs., 6 figs., 1 tab.

**34445** (EGG-M–91291) **Modeling key cupola reactions: Behavior of carbon, silicon and manganese.** Sahajwalla, V. (Michigan Univ., Ann Arbor, MI (United States). Dept. of Materials Science and Engineering); Pehlke, R.D.; Landefeld, C.F.; Katz, S. American Foundrymen's Society, Des Plaines, IL (United States). [1991]. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC07-89ID12869. (CONF-9105259–1: 95. castings congress, Birmingham, AL (United States), 5-9 May 1991). Order Number DE91018746. Source: OSTI; NTIS; GPO Dep.

In the present study, models of key chemical processes governing the compositions of the tapped metal from the cupola on the basis of physico-chemical fundamentals have been developed. As evident from the literature survey, the investigations conducted in the past have focused their attention on one phenomenon at a time; for example, a particular chemical reaction, measurement of gas composition or the temperature distribution inside a cupola. Notwithstanding the importance of these studies and their contribution toward the understanding of cupola operation, mathematical models of key chemical processes and their interdependence must be investigated to obtain a complete insight into the various interlinked phenomena occurring inside a cupola. For example, the oxidation of the metallic charge leads to the formation of iron oxide which influences the final content of elements such as silicon, manganese and carbon. The processes considered in this study are oxidation of solid steel and cast iron, carbon pickup, and oxidation of carbon, silicon and manganese by $CO_2$ and FeO. A schematic view of a conventional cupola furnace is presented in Figure 1 which also lists the key chemical processes. The present work describes the different mathematical models, links their interactions, and compares the results of model predictions with measurements made on an operating cupola. 26 refs.

**34446** (FhG-IWM-W–13/90) **Improvement of the fatigue characteristics of steel components through selective application of surface residual stresses.** Zeller, R. Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany); Deutsche Forschungsgemeinschaft, Bonn (Germany). Dec 1990. 52p. (In German). Contract DFG Pr 207-2/2. Order Number DE92714295. Source: OSTI; NTIS (US Sales Only); INIS.

Higher pressure residual stresses and therefore improved fatigue strength characteristics can be achieved by an overlaid prestress during surface treatment; the preceding research project has shown this. Shot peening, stress peening, and rolling were the surface treatment techniques used. Between the applied prestress and the achieved pressure residual stress, a relationship had been found that could be described by a formula. On the one hand, a good correspondence resulted between the precalculated pressure residual stresses achieved in the case of shot-peened soft material states and rolled annealed material states; on the other hand, computation and reality in the case of shot peening of annealed steels deviated from each other. To clear up this discrepancy, the superposition of load burden stresses and residual stresses was monitored after the individual treatment steps and during release in the present investigation. (orig./MM).

**34447** (GKSS–91/E/7) **Fatigue behaviour of Cu-35%Ni-3,5%Cr alloy in different decomposition states.** Wang, G.X. (GKSS-Forschungszentrum Geesthaacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Werkstofforschung). GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany); Bremen Univ. (Germany). Fachbereich 4 - Produktionstechnik. 1991. 130p. (In German). Order Number DE92714350. Source: OSTI; NTIS (US Sales Only).

Fatigue behaviour of a spinodal alloy Cu-35%Ni-3,5%Cr under stress-controlled condition was investigated in air and argon, and over a wide decomposing range from solution-treated to overaged state. All states investigated exhibit cyclic hardening initially followed by cyclic softening. TEM-investigations show that the cyclic hardening is due to an increase of dislocation density, and the

cyclic softening can be attributed to rearrangement of dislocations in the solution-treated specimens and to dissolution of precipitates in the aged speciemens. LCF-strength can be improved through the spinodal decomposition, in a manner similar to tensile strength. However, with the increase in number of cycles to fracture S-N-curves of the aged specimens approach that of the solution-treated. This is correlated with the fraction of intergranular fracture which increases with the increase in number of cycles to fracture. The extend of intergranular crack initiation and propagation can be reduced in argon, hence, HCF-strength is about 30-50% higher than that in air. (orig.) With 88 figs., 9 tabs.

**34448** (IAEA-TECDOC–572, pp. 75-89) **Dosimetry and radiation damage in high-energy neutron fields; nuclear data needs.** Boerman, D.J. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Dierckx, R.; Dupasquier, A; Sangiust, V.; Trincherini, P. International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

Irradiation experiments at spallation neutron sources are of particular interest in view of the development of such a source for fusion simulated radiation damage experiments. Such an irradiation is executed in a spallation neutron spectrum at the beam stop of LAMPF, Los Alamos. This neutron spectrum is much harder than a fission spectrum, a few percent of the neutrons have energies above 10 MeV and up to some hundreds of MeV. Temperature during irradiation was 140 deg. C. The neutron spectrum is monitored by monitor foils. From the foil activities the spectrum is deduced by unfolding codes. The irradiation has reached a fluence of $2.21 \times 10^{19}$ n/cm$^2$. It is found that the spallation neutrons are accompanied by a few percent of high energy protons. On some foils total He production and solid transmutation products are measured. On a Ni foil the radiation damage is measured by positron annihilation. Tensile-tests are executed on Al probes. Cross-section data needs are discussed. (author). 17 refs, 3 figs, 5 tabs.

**34449** (IAEA-TECDOC–572, pp. 103-109) **Radiation damage calculations for compound materials.** Greenwood, L.R. (Argonne National Lab., IL (USA)). International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

Displacement damage calculations can be performed for 40 elements in the energy range up to 20 MeV with the SPECTER computer code. A recent addition to the code, called SPECOMP, can intermix atomic recoil energy distributions for any four elements to calculate the proper displacement damage for compound materials. The calculations take advantage of the atomic recoil data in the SPECTER libraries, which were determined by the DISCS computer code, using evaluated neutron cross section and angular distribution data in ENDF/B-V. Resultant damage cross sections for any compound can be added to the SPECTER libraries for the routine calculation of displacements in any given neutron field. Users do not require access to neutron cross section files. Results are presented for a variety of fusion materials and a new ceramic superconductor material. Future plans and nuclear data needs are discussed. (author). 11 refs, 6 figs, 1 tab.

**34450** (IAEA-TECDOC–572, pp. 111-129) **The effect of nuclear transmutations under neutron irradiation on mechanical properties of reactor structural materials.** Ryazanov, A.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Borodin, V.A.; Manichev, V.M. International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents a short review of the principal nuclear transmutations in irradiated reactor structural materials and the effect of transmutant accumulation on irradiation stability of these materials, in particular, on swelling, irradiation creep, and high temperature embrittlement. (author). 20 refs, 20 figs, 1 tab.

**34451** (INIS-SU–266, pp. 133) **Structural changes in nickel alloys during radiation heat treatments.** Zajtseva, N.M. (Tomskij Gosudarstvennyj Univ., Tomsk (USSR). Sibirskij Fiziko-Tekhnicheskij Inst.); Elizar'eva, L.Yu.; Volodina, I.I.; Kulikov, V.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NICKEL BASE ALLOYS/phase studies; NICKEL BASE ALLOYS/physical radiation effects; ALUMINIUM ALLOYS; ANNEALING; COBALT 60; GADOLINIUM ADDITIONS; HIGH TEMPERATURE; RADIATION DOSES; TUNGSTEN ALLOYS; YTTRIUM ADDITIONS

**34452** (INIS-SU–266, pp. 134-135) **Influence of ~-radiation on thermal stability of disperse oxide phase in nickel.** Zajtseva, N.M. (Tomskij Gosudarstvennyj Univ., Tomsk (USSR). Sibirskij Fiziko-Tekhnicheskij Inst.); Volodina, I.I.; Kulikov, V.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 fig. NICKEL BASE ALLOYS/physical radiation effects; YTTRIUM OXIDES/physical radiation effects; ZIRCONIUM OXIDES/physical radiation effects; COBALT 60; DEBYE TEMPERATURE; DISPERSION HARDENING; DISTRIBUTION FUNCTIONS; PARTICLE SIZE; PHASE TRANSFORMATIONS; RADIATION DOSES

**34453** (INIS-SU–266, pp. 162) **Impurity diffusion in nuclear doped silicon.** Svistel'nikova, T.P.; Moiseenkova, T.V.; Stuk, A.A.; Kharchenko, V.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. SILICON/diffusion; SILICON/radiation effects; DIFFUSION LENGTH; IMPURITIES; SILICON; DIFFUSION

**34454** (INIS-SU–266, pp. 171-172) **Regularities and mechanism of radiation-induced atmospheric corrosion of metals.** Udachin, S.R. (Leningradskij Tekhnologicheskij Inst., Leningrad (USSR)); Petrik, N.G.; Makarchuk, T.F.; Sedov, V.M.; Nechaev, A.F. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p.

(In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only): INIS.

Short note. MOLYBDENUM/corrosion; MOLYBDENUM/radiation effects; NIOBIUM/corrosion; NIOBIUM/radiation effects; STEEL-CR18NI10TI/corrosion; STEEL-CR18NI10TI/radiation effects; ZIRCONIUM BASE ALLOYS/corrosion; ZIRCONIUM BASE ALLOYS/radiation effects; AIR; COBALT 60; MOLYBDENUM; CORROSION; NIOBIUM; RADIATION DOSES; STEEL-CR18NI10TI

**34455** (INIS-SU–272) **Radiation materials science. V. 1.** AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990 228p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS; GPO Dep.

Individual papers are processed separately for the database. (DLC)

**34456** (INIS-SU–272, pp. 15-23) **Modern state and prospects for radiation resisting structural materials of fast reactor cores in USSR.** Reshetnikov, F.G. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)); Troyanov, M.F.; Mitenkov, F.M. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Results of realization of the 1st Complex program on the development of radiation resistant materials for the fast reactor cores and problems set in the 2nd Complex program, adopted in 1988, are reported. Several modifications containing boron, silicon and titanium for producing fuel element cans are developed on the base of 0Kh16N15M3B steel. To produce hexahedral FA cans ferritic martensitic Kh13M2BFR steel is recommended. A detailed investigation into austenitic 16 % Cr - 20 % Ni - 3 % Mo steel with the carbon content of no more than 0.03 % and titanium - of about 1 %, is provided. Problems of using ferritic martensitic grade steels for producing both fuel cans and FA shrouds are considered. On this case it is necessary to provide for fuel element can temperature reduction. High-strength dispersion-strengthened chromium steels and methods of their processing are developed. Works on the optimization of the fuel element diameter, pellet design and reactor operation regime are conducted. 4 figs.

**34457** (INIS-SU–272, pp. 24-51) **Modern state and research problems in radiation damage physics and radiation effects on materials in USSR.** Zelenskij, V.F.; Bakaj, A.S.; Neklyudov, I.M. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

The state of the main problems of radiation materials science is considered including the radiation damage processes, defect structure evolution, dimensional changes in materials (swelling, creep), plasticity loss, corrosion acceleration, surface erosion. Change of chemical composition of the source material, development of measures on the improvement of radiation resistance of structural materials, as well as application of various methods of investigation (mathematic simulation, nuclear-physical methods, electron-field ion-X-ray microscopy etc). 76 refs.; 14 figs.

**34458** (INIS-SU–272, pp. 52-67) **Influence of displacement rate on damage accumulation during the point defect transient in irradiated materials.** Stoller, R.E. (Oak Ridge National Lab., TN (USA)); Mansur, L.K. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

The question about accumulation of damages under low-temperature irradiation is considered. Examples of steel radiation creep observed at lower than 300 deg C and accelerated embrittlement at 60 deg C are presented. In both cases a notable role of atom displacement rate is underlined. A detailed numeric analysis of displacement rate effect on the defect accumulation is conducted. 11 refs.; 11 figs.

**34459** (INIS-SU–272, pp. 68-74) **Irradiation creep and swelling of annealed type 304L stainless steel at 390 deg C and high neutron fluence.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (USA)); Porter, D.L.; Hudman, G.D. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation creep and swelling of cold-rolled annealed 304L type stainless steel under testings in the EBR-2 breeder reactor at 390 deg C are investigated. It is shown that the degree of swelling depends on the atom displacement rate and applied stresses. Radiation creep rate is proportional to the stress and instant swelling rate. 14 refs.; 5 figs.

**34460** (INIS-SU–272, pp. 75-81) **Irradiation creep and swelling of the fusion heats of PCA, HT9 and 9Cr-1Mo irradiated to high neutron fluence.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (USA)); Puigh, R.J. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation creep and swelling of samples of three materials (candidate alloy for the first wall (RSA), ferritic martensitic NT9 steel and 9Cr-1Mo type steel) under testing in the FFTF reactor within 400-600 deg C temperature range are investigated. It is ascertained that the radiation creep rate for all the three alloys is proportional to the applied stress and instant swelling rate. 12 refs.; 7 figs.

**34461** (INIS-SU–272, pp. 82-92) **Overview of copper irradiation programs in FFTF.** Garner, F.A. (Pacific Northwest Lab., Richland, WA (USA)); Hamilton, M.L.; Brager, H.R.; Anderson, K.R.; Stubbins, J.F.; Singh, B.N. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Review of investigations conducted at the FFTF reactor to determine copper and copper alloy applicability as the material for nuclear fusion facilities is presented. Generalization of results of the earlier conducted works is given as well. 14 refs.; 7 figs.

**34462** (INIS-SU–272, pp. 123-147) **Mechanistic understanding of irradiation corrosion of zirconium alloys in nuclear power plants: stimuli, status and outlook.** Cox, B. (International Atomic Energy Agency, Vienna (Austria)); Ishigure, K.; Johnson, A.B.; Lemalgnan, J.C.; Nechaev, A.F.; Petrik, N.G.; Reznichenko, E.A. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Extensive information about the corrosion behaviour of zirconium alloys under irradiation is presented. Review of the existing models of radiation corrosion is given. An accent is made on a necessity in conducting basic investigations to overcome contradictions in interpreting the experimental data available. Importance of solving the problem of zirconium alloy corrosion for safe NPP operation is underlined. 34 refs.; 6 figs.; 4 tabs.

**34463** (INIS-SU–272, pp. 106-122) **Radiation resistant steels for pressurized water reactor vessels.** Amaev, A.D. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR,

Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.): Gorynin, I.V.; Ignatov, V.A.; Nikolaev, V.A.; Ryazantsev, E.P.; Shamardin, V.K. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

The scientific base to develop steels for pressurized water reactor vessel are presented. The radiation embrittlement and steel hardening relationship depending on Ni, Mn, Mo, P and Cu contents are shown. Radiation embrittlement mechanisms are related to defect formation and solute atom clusters and also to segregation of elements, which are able to cohesion decrease. The proposition are taken into account in development 15Kh2MFA and 15Kh2NMFA steels. It is shown that dose radiation embrittlement relationship is expressed as power function with power increase in the range 0.35...0.5-1% Ni for alloyed steel. 7 refs.; 7 figs.

**34464** (INIS-SU–272, pp. 148-159) **New approach to radiation damage.** Schule, W. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Comparison of three models of radiation-induced diffusion in alloys is conducted. Experimental data for Cu-Zn alloy, gold and nickel are analysed. It is proposed to use the chemical reaction rate equation to calculate the point defect migration activation energy. 29 refs.; 12 figs.; 1 tab.

**34465** (INIS-SU–272, pp. 160-174) **Structural phase transformations under irradiation.** Bakaj, A.S. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

The following problems of the theory of structural-phase transformations in alloys under irradiation are considered: kinetics of nucleation, precipitate growth, phase equilibria, radiation-induced polymorphous trans formations, formation of the size distribution of precipitates during cascade-producing irradiation. The possibility of development of an ergodic structure in an alloy, which is highly resistant to radiation damage, is also discussed. 41 refs.

**34466** (INIS-SU–272, pp. 196-203) **Technique development and study of radiation-induced embrittlement and creep using high energy electron and gamma-quantum beams.** Zelenskij, V.F.; Neklyudov, I.M.; Ozhigov, L.S.; Gann, V.V.; Parkhomenko, A.A.; Borts, B.V.; Stefanov, V.F. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Based on fundamental investigations in the field of material radiation damagability, a method of simulation and study of basic mechanical properties of materials using $\gamma$-quantum and high-energy electron beams, allowing one to simultaneously simulate radiation damages, produced under material operation in nuclear and thermonuclear reactors with different ratio of helium introduction rate to damage formation rate in one and the same experiment is proposed and scientifically grounded. The method is used to simulate and study the phenomena of radiation hardening, low- and high-temperature radiation embrittlement, radiation creep. Correlation between reactor and simulation experiments is ascertained which allows one to forecast changes of material mechanical properties under the operation conditions. 11 refs.; 2 figs.

**34467** (INIS-SU–272, pp. 184-195) **Irradiation creep in engineering alloys.** Matthews, J.R. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

The problem of radiation creep of alloys comprising solid solutions and excessive phase releases is considered. The role of dissolved element in the point defect dynamics and dislocation structure and phase composition effects on radiation creep mechanism are discussed. Two groups of radiation creep mechanism are investigated. The first group of models considers the creep reason directly in the occurrance of point defect flow. According to the other class of models deformation under creep takes place as a result of dislocation sliding the rate of which is controlled by radiation induced dislocation creep. 24 refs.

**34468** (INIS-SU–272, pp. 175-183) **Decrease of radiation effects on embrittlement and creep of steels and alloys using REM microalloying.** Zelenskij, V.F. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Neklyudov, I.M.; Ozhigov, L.S.; Zejdlits, M.P.; Parkhomenko, A.A.; Stefanov, V.F.; Karasev, B.S.; Shamardin, V.K.; Neustroev, V.S. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Results of investigations into REM (La, Pr, Sc) microalloying effect on short-term mechanical properties of nickel and austenitic stainless steels irradiated with charged particle beams and in reactors up to the maximum fluence of 70 dpa, are presented. It is ascertained that REM microalloying leads to an increase of radiation creep resistance, inprovement of deformation properties; it increases resistance to low- and high-temperature embrittlement. Resistance to radiation swelling is increased at the optimal alloying and heat treatment. The results obtained allow one to recommend KhNS type steels with optimal content of the alloying element and thermal treatment for fast reactor testing as the core products. 8 figs.

**34469** (INIS-SU–272, pp. 204-212) **Use of computerized simulation in radiation material science.** Kirsanov, V.V. (Kalininskij Politekhnicheskij Inst., Kaliningrad (USSR)); Gann, V.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

Short review of some results on radiation damage physics, obtained in USSR with the use of computer simulation method is presented. New results on radiation damage dynamics in multicomponent crystals, atomic configurations and properties of defect clusters, mechanism of interaction between point defects, dislocations and grain boundaries. Computer simulation is shown to increase our knowlege in the field of radiation swelling. 40 refs.

**34470** (INIS-SU–272, pp. 213-218) **Diffusion depletion of solid solutions under irradiation.** Trushin, Yu.V. (AN SSSR, Leningrad (USSR). Fiziko-Tekhnicheskij Inst.). AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 228p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 1.* Order Number DE92001305. Source: OSTI; NTIS (US Sales Only); INIS.

The theoretical description of diffusion evolution of a defect structure under irradiation is complicated by two given alloy components. Therefore, providing that some simplifying assumptions are made, it is possible to write down, for a substitional solid solution, a system of four equations describing the concentrations of interstitionals, vacancies, impurity and complexes. Such systems are possible to solve analytically as applied to some limiting cases, for example to those of the solid solution slowly and fastly depleted with impurity. There can be also obtained some regularities for precipitate growth in both limiting cases with solving the diffusion equations for the concentration distributions of point defects in the vicinity of sinks. 9 refs.; 2 figs.

**34471** (INIS-SU–273/A, pp. 3-9) **Mechanism of vacancy loops nucleation in alpha-iron.** Kapinos, V.G. (Gosudarstvennyj

Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR. Moscow (USSR). Inst. Atomnoj Ehnergii); Osetskij, Yu.N.; Platonov, P.A. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247--: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The mechanism of nucleation of perfect vacancy loops (VL) with Burgers vector b=<100> in BCC metals in suggested. The mechanism takes into account the experimental fact that the nucleation of such loops takes place exclusively in cascade regions of damage. The computer simulation method have shown that the shift leading to the VL formation with b=<100> is the most probable for a dense threedimensional vacancy clusters (VC) which has over 20-35 % of vacancies not being part of the vacancy disk of (110) critical size. With nucleating the VC as an isolated disk of > 46 vacancies the spontaneous shift reaction is realized always, resultion in the formation of the perfect loop with b=1/2<111>. 8 refs.; 2 figs.

**34472** (INIS-SU--273/A, pp. 10-16) **Diffusion mechanism of evolution of void ensemble under irradiation.** Dubinko, V.I.; Ostapchuk, P.N.; Slezov, V.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (CONF-9005247--: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

We derive a diffusion growth rate of a void in the mean field approximation taking into account the volume fraction of voids and dislocations, their elastic interaction with point defects and the finite rate of void boundary kinetics. All this factors are shown to influence the void bias factor, which is inversaly proportional to the void sise in the diffusion limited approximation. As a result of such dependence a mechanism of radiation-induced coarsening arises which limits the maximum number density of growing voids to the value dependet only on the dislocation structure and material constans, which is in agreement with experimental observations. 12 refs.

**34473** (INIS-SU--273/A, pp. 17-24) **Effect of dislocation-point defect interaction on dislocation mobility and solid solution decomposition in various crystal classes.** Chernov, V.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.). AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247--: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

Within the framework of the anisotropic elasticity theory the influence of the dislocation-poit defects (elastic dipoles) interaction on dislocation mobility and decay of solid solutions formed by impurity and inherent point defects has been investigated. Consideration is given for the main types of dislocations and elastic dipoles allowed by the symmetry of FCC, BCC and HCP lattices. A qualitative difference between the influence of various dislocations on solid solutions decay is observed, resulting in the considerable differences in formation of physical and mechanical properties (strengthening, swelling, etc.) in various crystal structures. The controlling parameters are the lattice symmetry and the values of crystal elastic modules (the degree of elastic anisotropy). 12 refs.

**34474** (INIS-SU--273/A, pp. 45-57) **Effect of rare-earth elements on radiation resistance of materials.** Zelenskij, V.F.; Neklyudov, I.M. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247--: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The report presents the results from studies of the influence of rare-earth elements (REE) on the structure and properties of irradiated metals and alloys. Alloying of materials with REE essentially increases their radiation resistance. Possible mechanisms of REE influence on radiation resistance of materials are discussed. 24 refs.; 8 figs.

**34475** (INIS-SU--273/A, pp. 58-69) **Annealing of radiation defects in Ni and Ni-Sc alloys. Experiment and computer simulation.** Volobuev, A.V.; Gann, V.V.; Neklyudov, I.M.; Petrusenko, Yu.T.; Sleptsov, A.N. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247--: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

Investigations of low temperature radiation defect annealing in Ni and Ni-Sc-alloys after high energy electrons irradiation with using electrical resistivity recovery technique are carried out. Computer simulation of suggested mechanism of point defect annealing is carried out for experimental results interpretation. Nonsteady-state and temperature dependent equations of rate theory are solved numerically. The whole set of equations takes into account diffusion and interaction of vacancies, interstitials, impurity atoms and complexes impurity atom-radiation defect. It is shown, that this method allowes to interpret the experimental results correctly and to determine the defect annealing mechanisms. 6 refs.; 5 figs.; 3 tabs.

**34476** (INIS-SU--273/A, pp. 70-79) **Electronic properties of $He^+$ implanted anodic oxide films formed on titanium.** Gorse, D.; Serruys, Y.; Rondot, B. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (CONF-9005247--: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The electronic properties of $He^+$ implanted anodic oxide films formed on titanium under galvanostatic control are investigated by photoelectrochemistry (PEC) at two different stages of the growth process. This technique shed in light differences in the implantation effects as a function of the final formation potential attained: $He^+$ implantation modifies markedly the electronic structure of thin films obtained at low formation potential ($V^{max}$=20V/SCE), but exert no significant influence on thick films grown at high formation potential ($V^{max}$=100V/SCE). In both cases, a doping effect due to $He^+$ implantation in revealed. 8 refs.; 3 figs.

**34477** (INIS-SU--273/A, pp. 88-101) **Elevated temperature tensile properties of Mg-0.8%Al alloy in irradiated and unirradiated condition.** Bischler, Ph.J.E. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (CONF-9005247--: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

In the United Kingdom magnesium alloys have been used in nuclear fuel cladding applications for over 30 years. The mechanical properties of a Mg-0.8%Al alloy have been examined over a range of strain rates at temperatures between 20 and 500 deg C. The variation in ultimate tensile strength, 0.1% proof stress and ductility to failure with test temperature has been evaluated for unirradiated material. These results are compared with data published by other researchers. Similar tests have been carried out on highly irradiated material, machined from actual reactor components, to determine the effect of long term exposure to a neutron flux. Selected irradiated and unirradiated specimens have been examined using optical and scanning electron microscopic techniques to determine the fracture mode. 10 refs.; 15 figs.

**34478** (INIS-SU--273/A, pp. 26-33) **Accelerated embrittlement based on increased point defect survival in soft neutron spectra.** Mansur, L.K. (Oak Ridge National Lab., TN (USA)); Farrell, K. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (CONF-9005247--: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

Recent experimental data on ductility of ferritic steels irradiated at low damage rates in highly thermalized neutron spectra. In particular, we suggest that a thermalized spectrum leads to the production of a large fraction of the point defects in very small cascades. This enhances the probability that the defects may avoid

in-cascade recombination. and therefore remain available to accelerate the microstructural changes that lead to embrittlement. Preliminary experimental evidence is described that supports these suggestions. 11 refs.: 6 figs.

**34479** (INIS-SU–273/A. pp. 102-109) **Phase equilibrium in binary alloys under irradiation.** Turkin, A.A.: Bakaj, A.S. AN Ukrainskoj SSR. Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR). 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper we consider the effect of radiation-induced segregation on the growth of second-phase precipitates in a substitutional binary alloy and develop the method to construct the radiation-midified phase diagram as well as the temperature-dose rate diagram. The general idea of our approach is as follows: the points of the diagram in which the transformation rate (in our case the precipitate growth rate) goes to zero form the phase equilibrium curve separating stability regions of corresponding structural-phase states. It turns out that the stability oriteria for coherent and incoherent precipitates differ. This means that under irradiation the thermal solvus splits up into two curves. The calculations of diagrams are carried out for Ni-Si, Ni-Al and Al-Zn alloys. 12 refs.; 5 figs.

**34480** (INIS-SU–273/A. pp. 110-116) **Effect of neutron and helium ion irradiation on structural changes in 0Kh18N40 type alloys.** Panteleev, L.D. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov. Moscow (USSR)); Sokurskij, Yu.B.; Krivova. V.I.; Uvarov, N.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The paper studies structural changes effected by anneal and irradiation in two alloys of the 0Kh18N40 system: in 0Kh18N40M5Gb (GB alloys), as solid solution and in precipitation hardened 0Kh18N40M5GTYuR (TYuR alloys). It is shown that structurally less stable TYuR alloy is more resistent to irradiation induced swelling (~ 0.15%) than the structurally stable GB alloy (~ 14 %) at a fluence of $1.3x10^{23}$ fast n/cm$^2$ and a temperature of 500 deg C. Electron microscopic and X-ray diffraction methods were used to study structural changes occuring in the alloys under anneal having a significantly different character. The paper discusses the mechanism of structural changes in the alloys under irradiation and the relationship between the structural and volume changes. 4 refs.; 2 figs.

**34481** (INIS-SU–273/A, pp. 117-126) **Radiation swelling of high nickel steels and alloys inclined to short ordering.** Kuznetsov, A.A.; Kursevich, I.P.; Nikolaev, V.A.; Rybin, V.V.; Lapin, A.N. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

Void swelling of some model Fe-15Cr-xNi ternary alloys and complex commercial NiCrMo3Nb 32 20, NiCrMo 35 15 and NiCr20Mo4Nb alloys after neutron irradiation by fluence up to $1.3x10^{27}$ m$^{-2}$ (E > 0.1 MeV) are investigated. The effect of ternary alloys swelling decrease with increase of nickel content is confirmed and explained by short ordering. It was shown that the beneficial influence of short ordering in complex alloys may decline as a result radiation-induced phase precipitation with promote vacancy void growth. 7 refs.; 4 figs.; 1 tab.

**34482** (INIS-SU–273/A, pp. 127-140) **Study of suppression methods of radiation swelling in austenitic steels of 16-15 type under fast neutron irradiation.** Nalesnik, V.M. (Nauchno-Issledovatel'skij i Konstruktorskij Inst. Ehnergotekhniki, Moscow (USSR)); Sagaradze, V.V.; Barsanov, V.I.; Kozlov, A.V.; Lapin, S.A. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The results on radiation forming studies of austenitic steels with different composition under fast neutron irradiation at operation temperatures are presented. The influence of main doped and microdoped elements (Al. Ti, Ca, Mg and others) on radiation swelling is shown. The efficiency of steel swelling suppression by cold working and also by Ti-modification, forming a dispersed phase under irradiation is studied. Posssible usage of irradiated age-hardenable austenitic steels with slow swelling of the 16-15 type is shown. 20 refs.; 5 figs.; 1 tab.

**34483** (INIS-SU–273/A, pp. 141-148) **Vacancy swelling theory of binary alloys.** Golubov, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.). AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The present paper considers the effect of mutual diffusion of alloy components on the relative sink strength for point defects. It is shown, that radiation-induced segregation on the sink, including moving dislocations, results in a significant modification of the bias for swelling. The effect of preliminary thermomechanical processing of alloys and radiation conditions on the alloy swelling are discussed. 3 refs.; 2 figs.

**34484** (INIS-SU–273/A. pp. 149-155) **Dislocation mechanism of void ordering and saturation of radiation swelling of metals.** Dubinko, V.I. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

Evolution of cavity ensemble under irradiation is considered with account of elastic interaction of cavities with point defects and dislocation loops. The interaction with point defects results in a mechanism of radiation-induced coarsening, while the interaction with loops leads to the dislocation mechanism of cavity growth or shrinkage. A coopration of this mechanisms at different irradiation conditions is shown to result in such fenomena as void and bubble ordering, bimodal size distribution formation and saturation of swelling. 9 refs.

**34485** (INIS-SU–273/A, pp. 156-163) **Stability of second-phase precipitations under high dose irradiation.** Bakaj, A.S.; Borodin, O.V.; Bryk, V.V.; Voevodin, V.N.; Neklyudov, I.M.; Platonov, P.V.; Turkin, A.A. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

Analysis of phase microstructure of steels irradiated at temperatures, where phase stability changes due to radiation-induced segregation, shows that the stability of second-phase particles depends on the structure of particle-matrix interface. Coherent precipitates and precipitates with small degree of incoherency evolve slowly and are the most stable under irradiation. Coherency loss results in compositional changes around the precipitate. This leads either to dissolution of the precipitate or to phase transformation with alterations of the compositon and the lattice of the precipitate. 8 refs.; 5 figs.; 1 tab.

**34486** (INIS-SU–273/A, pp. 164-172) **New aspects of gas-induced swelling in helium implanted nickel.** Chernikov, V.N. (AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii); Kazanskij, P.R.; Zakharov, A.P.; Trinkaus, Kh.; Yung, P.; Ull'majer, Kh. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

At high temperature annealing of Ni implanted with helium at 300 K the gas-induced swelling proceeds in two stages. At first the primary gas porosity forms: in the course of annealing it undergoes the transformation into the secondary one, which is accompanied by a strong increase in gas swelling at the expence of thermal vacancies. A kinetic model of the secondary swelling front movement is suggested. It is shown that the transformation process of the gas porosity is connected with the change of coarsening mechanism which becomes possible possible because of the relaxation of the over pressure in primary bubbles. 10 refs.;5 figs.

**34487** (INIS-SU–273/A, pp. 173-181) **Influence segregation processes on radiation effects in vanadium, niobium and molybdenum alloys at different temperatures of neutron irradiation.** Kazakov, V.A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)); Goncharenko, Yu.D.; Pokrovskij, A.S.; Anisimov, Yu.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The results of investigations on radiation-induced segregation (RIS) of elements on the surface of niobium and vanadium alloys after neutron irradiation at $1.1x10^{23}$ $cm^{-2}$ fluence and the temperature range 460...1100 deg C are presented. Segregation of tungsten, zirconium, titanium and chromium is discovered as well as surface molybdenum depletion. 50-70 % of tungsten is observed in the surface layer to 30 nm thick with its 2.4 % content in matrix (excluding carbon and oxygen). The correlation between voidage suppression in molybdenum, vanadium and niobium alloys and formation process of radiation-induced precipitation is analyzed. The results of RIS investigation on external sinks are supposed to be used for simulation of chemical elements diffusion fluxes and of radiation defects on internal sinks. 7 refs.; 7 figs.

**34488** (INIS-SU–273/A, pp. 182-188) **Effect of decrease of molybdenum radiation hardening at high energy proton irradiation.** Reutov, V.F. (AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Yadernoj Fiziki); Vagin, S.P.; Turubarova. L.G. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

By method of transmission electron microscopy and measuring of microhardness the peculiarities of influence of radiation defect clusters on molybdenum radiation hardening along range path of protons with 30 MeV initial energy are studied. Decrease effect of hardening growth value and even its absence depending on irradiation dose in the range of 10-20 MeV proton energies in presence of high density of radiation defect dispersed clusters is revealed. It is shown experimentally that this effect is connected with accumulation of hydrogen up to not very high concentrations (not more than $5x10^{-4}$ at.%) at the expense of elastic and inelastic proton scattering. 5 refs.; 5 figs.

**34489** (INIS-SU–273/A, pp. 189-196) **Dislocation loop growth in molybdenum under HVEM irradiation.** Botvin, K.V. (AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Yadernoj Fiziki); Khjirsanov, V.V.; Reutov, V.F. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The equation system of diffusion have been solved to describe the interstitial dislocation loop growth under HVEM irradiation. The role of the mobile di-vacancies, impurity traps and dependence of dislocation loop growth on the distance from surface too was discussed. The temperature depended growth rate at steady-state is considered. All calculations was made by using the parameters of molybdenum. 10 refs.; 5 figs.

**34490** (INIS-SU–273/A, pp. 197-213) **Helium and hydrogen effects in fusion reactor materials.** Al'tovskij, I.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii): Grigoryan, A.A.: Vinokurov, V.F.; Rybin. V.V.; Fabritsiev, S.A. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

Effects of helium and hydrogen production from fusion reactor are summarized for austenitic steels. It is shown that observations of microstructural sensitivity to helium are providing important clues for developing damage resistant structural alloys for fusion reactor applications. The results shown that helium and displacement damage produced a small in crack propagation resistance and in fatigue when compared with unirradiated test results. 33 refs.; 5 figs.; 1 tab.

**34491** (INIS-SU–273/A, pp. 221-227) **Correlation between low-temperature creep and intergranular diffusion of Kh16N15M3B type steel.** Solonin, M.I. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Neorganicheskikh Materialov, Moscow (USSR)); Kondrat'ev, V.P.; Krasina, T.A.; Voejkov, V.P.; Tarasyuk, V.B.; Fedorov, G.B.: Ryabenko, A.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The results are presented for Kh16N15M3B type steel containing different amounts of carbon, molybdenum and niobium that was tested the diffusion mobility of iron-59 species. It is shown that at 400-500 deg C the diffusion of iron-59 is only intergranular. The correlation established between creep and diffusion. It is shwn that the activation energies for creep and intergranular diffusion correlate. 5 refs.; 4 figs.; 3 tabs.

**34492** (INIS-SU–273/A, pp. 214-220) **Creep mechanism change in metals under irradiation.** Karasev, V.S. (AN Uzbekskoj SSR, Tashkent (USSR). Inst. Yadernoj Fiziki); Totskij, A.Yu. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1990. 251p. (In Russian). (CONF-9005247–: International conference on radiation material science, Alushta (USSR), 22-25 May 1990). In *Radiation materials science. V. 2.* Order Number DE92001308. Source: OSTI; NTIS (US Sales Only); INIS.

The model of changing in mechanism of irradiation creep has been proposed. The phenomenon is characterized by minimum appearence on the curve of temperature dependence of steady state irradiation creep and connected with the point defects-dislocations interaction. Assumption has been confirmed experimentaly by the transient irradiation creep investigations. 5 refs.: 6 figs.

**34493** (IS-T–1542) **The structure and energetics of gas phase Ni and Pd clusters.** Stave, M.S. Ames Lab., IA (United States). 21 Aug 1991. 165p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE91018287. Source: OSTI; NTIS; GPO Dep.

The structure and energetics of $Ni_N$ and $Pd_N$ clusters ($4 \leq N \leq 23$) are investigated using a corrected effective medium (CEM) theory. Computational developments enabling this research are also discussed-including the formulation of the analytic derivative of the kinetic, exchange and correlation energy functionals within the additive density approximation of the CEM theory and its implementation onto a nCUBE 2 hypercube computer. Unique structural features of these metals clusters are noted especially in relation to the bulk and surfaces phases of Ni and Pd and to structures commonly associated with rare gas clusters. For many cluster sizes stable structures of the transition metal clusters differ substantially from those rare gas clusters. These differences are rationalized in terms of the differences in the nature of the atomic interactions in the two types of systems. 121 refs., 26 figs.

**34494** (IS-T–1564) **Tribological and arc erosion behaviors of copper-refractory metal in situ composites.** Liu, Ping. Ames Lab., IA (United States). 6 Aug 1991. 171p. Sponsored by USDOE,

Washington. DC (United States). DOE Contract W-7405-ENG-82. Order Number DE91018286. Source: OSTI: NTIS: GPO Dep.

Thesis submitted to Iowa State Univ.

Tribological and arc erosion behaviors of Cu-Nb and Cu-Cr in situ composites were investigated in this dissertation. Dry sliding tests were performed in a pin-on-disk wear tester with the composites rubbing against a rotating tool steel disk under ambient conditions with a pressure of 0.68 M Pa, sliding speeds up to 2.5 m/s, and electrical current densities up to 2.89 $MA/m^2$. Electrical arc erosion tests were performed in a make-and-break test set-up and a high-energy stationary arc gap test facility. Sliding friction and wear behaviors of Cu-Nb composites with and without electrical loads were studied in terms of the effects of composition, filament orientation, true deformation strain, sliding speed and annealing temperature. The Cu-20vol.%Nb composite had the best wear resistance among the compositions studied in both cases. Subsurface deformation was revealed by the presence of filaments and was one of the wear mechanisms for the composites. No debonding was observed in the composites during sliding. The presence of electrical current increased the temperature and promoted oxidation on wear surfaces. The contact behavior of Cu-Nb composites against tool steel was studied in terms of the contact resistance and temperature rise. Surface oxide film development, wear particle accumulation, and unsteady contact caused by sliding were found to be the major factors governing electrical contact resistance and, therefore, temperature rise. Arc erosion behavior of the composites was also investigated.

**34495** (JAERI-M–91-092) **Deposition behaviors of radioiodine onto SUS304 stainless steel and 2 1/4Cr-1Mo steel surfaces.** Nakashima, Mikio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Saeki, Masakatsu; Sagawa, Chiaki; Masaki, Nobuyuki; Hirabayashi, Takakuni; Aratono, Yasuyuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 19p. (In Japanese). Order Number DE92704101. Source: OSTI; NTIS (US Sales Only); INIS.

This paper reports deposition behaviors of iodine onto SUS304 stainless steel and 2 1/4Cr-1Mo steel surfaces, which were under a temperature gradient condition in pure He or He containing 10% of oxygen gas (10%$O_2$/He). Under flowing pure He gas, iodine was deposited on the SUS304 stainless steel surface at a temperature above 200degC with the peaks at about 300degC and 500degC. It is considered that iodine is chemisorbed on the steel surface as a metal iodide, most probably iron iodide. In the 10%$O_2$/He atmosphere, majority of iodine condensed on the surface of temperature below the melting point of molecular iodine. On the other hand, in the case of 2 1/4Cr-1Mo steel surface, iodine was deposited at temperature above 250degC in both pure He and 10%$O_2$/He atmospheres. These results imply that not only the atmospheric condition but also the nature of surface oxides formed on the steel surfaces strongly affects on the deposition behaviors of iodine species. (author).

**34496** (Juel–2456) **Local investigation of magnetic structures in superconductors by a low-temperature scanning tunneling microscope.** Berthe, R. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Schicht- und Ionentechnik; Giessen Univ. (Germany). Mar 1991. 128p. (In German). Order Number DE92711317. Source: OSTI; NTIS (US Sales Only); INIS.

A low temperature scanning tunneling microscope device was constructed which allows a simultaneous spectroscopic and morphological measurement up to 4.2 K and 1T. Layers of niobium and $NbSe_2$ were measured and flux lines were determined. (WL).

**34497** (Juel–2461) **Development of a Sinter/HIP process for the superalloy Udimet 700 with investigations of the influence of the sinteratmosphere.** Wenning, L. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Angewandte Werkstofforschung; Technische Hochschule Aachen (Germany). Mar 1991. 133p. (In German). Order Number DE92711318. Source: OSTI; NTIS (US Sales Only); INIS.

The oxidation free treatment of reactive metalpowders like the nickel base alloy Udimet 700 demands sufficient oxygen free sinteratmospheres in nowadays sinter-HIP plants are not reachable. The reported work deals with the development of a sinter-HIP process which enables a sufficient low partial pressure of oxygen by scavenging the Udimet 700 powder packings with argon during vacuum sintering. By this the sinter hindering oxidation is avoided. Intensive investigations of the sinteratmosphere with a mass spectrometer and a zirconium oxide probe verify the reduction of the oxygen content of the residual gas atmosphere reached with different processes. In a second part the applicability of the scavenging gas process during the capsule free sinter-HIP treatment of metall injection moulded (MIM) samples is shown. (orig.).

**34498** (KCP–613-4397) **CNC water-jet machining and cutting center: Final report.** Bartlett, D.C. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Sep 1991. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. Order Number DE92000661. Source: OSTI; NTIS: GPO Dep.

CNC water-jet machining was investigated to determine the potential applications and cost-effectiveness that would result by establishing this capability in the engineering shops of Allied-Signal Inc., Kansas City Division (KCD). Both conductive and nonconductive samples were machined at KCD on conventional machining equipment (a three-axis conversational programmed mill and a wire electrical discharge machine) and on two current-technology water-jet machines at outside vendors. These samples were then inspected, photographed, and evaluated. The current-technology water-jet machines were not as accurate as the conventional equipment. The resolution of the water-jet equipment was only $\pm$0.005 inch, as compared to $\pm$0.0002 inch for the conventional equipment. The principal use for CNC water-jet machining would be as follows: Contouring to near finished shape those items made from 300 and 400 series stainless steels, titanium, Inconel, aluminum, glass, or any material whose fabrication tolerance is less than the machine resolution of $\pm$0.005 inch; and contouring to finished shape those items made from Kevlar, rubber, fiberglass, foam, aluminum, or any material whose fabrication specifications allow the use of a machine with $\pm$0.005 inch tolerance. Additional applications are possible because there is minimal force generated on the material being cut and because the water-jet cuts without generating dust. 12 figs.

**34499** (KU-HCOE-FL2-R–91-03) **Melting, growth and faceting of lead precipitates in aluminium.** Grabaek, L. (Risoe National Lab., Roskilde (Denmark). Physics Dept.); Bohr, J.; Robinson, I.K.; Andersen, H.H.; Johansen, A.; Johnson, E.; Sarholt-Kristensen, L. Copenhagen Univ. (Denmark). H.C. Oersted Inst. 1991. 35p. Order Number DE92601042. Source: OSTI; NTIS (US Sales Only); INIS.

Aluminum single crystals cut in the <111> direction were implanted with $2x10^{20}$ $m^{-2}$ $Pb^+$ ions at 75 keV or 150 keV. The implanted insoluble lead precipitated as epitaxially oriented crystallites in the aluminum matrix. The precipitates were studied by X-ray diffraction at Risoe, DESY and Brookhaven, and showed large superheating as well as supercooling during repeated heating cycles. The as-implanted precipitates had a characteristic size of proportional to 140 A which grew to 210-260 A during repeated heating cycles. A detailed annealing study shows that the growth rate of the precipitates changes discontinuously at the onset of melting. This shows that significant precipitate growth takes place by coalescence. The diffracted X-ray intensities, showed characteristic truncation rods (streaks) indicating that the solid precipitates were octahedra limited by {111} planes and truncated at the corners by {100} facets. (orig.).

**34500** (LA-UR–91-1292) **Numerical simulation of plasticity at high strain rate.** Margolin, L. (Los Alamos National Lab., NM (USA)); Flower, E.C. Los Alamos National Lab., NM (United States). [1991]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-911225–1: 1991 American Society of Mechanical Engineers (ASME) winter meeting, Atlanta, GA (United States), 1-6 Dec 1991). Order Number DE91011403. Source: OSTI; NTIS; GPO Dep.

In numerical simulations of solid dynamics, the total strain rates are calculated from the velocity fields and are input to the constitutive laws. For an elastic-plastic material, the strain rate for a computational cycle may cause the elastic stress to exceed the specified yield surface. This implies that the stress path must move

along the yield surface, and some of the strain is realized as plastic (irreversible) strain. The usual numerical method of integrating the elastic-plastic stress-strain relations is a construction procedure due to Wilkins. The virtue of this construction is that it is simple. Sometimes the procedure is inaccurate and leads to incorrect final stress states and plastic strain. In the computer programs, the computational time step is controlled so that the total strain rate can be assumed to be constant over a cycle. With this assumption, it is possible to find a simple yet exact expression for the final stress states for a large variety of yield surfaces. We will derive this expression assuming only that the yield surface does not explicitly depend on the deviator stresses themselves. A numerical program is used to compare the results of Wilkins' construction with new results for particular strain paths. 5 refs., 4 figs.

**34501** (LA-UR–91-1852) **High-temperature plasticity in copper polycrystals.** Chen, Shuh Rong; Kocks, U.F. Los Alamos National Lab., NM (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-911225–2: 1991 American Society of Mechanical Engineers (ASME) winter meeting, Atlanta, GA (United States), 1-6 Dec 1991). Order Number DE91014779. Source: OSTI; NTIS; GPO Dep.

A procedure for testing and analysis is described that elicits the material parameters for deformation at elevated temperatures and at strain rates high enough to make diffusion an unimportant mechanism. As a first step, a simple scaling procedure is used on continuous stress strain curves to reduce the data to essentially one curve; the differentiated, normalized hardening diagram. A unique curve of this kind is then assumed at the microscopic level: it reflects the mechanism of hardening and dynamic recovery through dislocation storage and rearrangement. It can be integrated for arbitrary straining paths; initial texture and texture changes can be incorporated at this step; they may affect macroscopic behavior substantially. The dependence of the scaling parameters on temperature and strain rate can be well treated by thermal activation theory. It allows a condensation of temperature and strain rate into a single combined and normalized variable which may then be plotted against a normalized stress. The behavior on this reduced diagram does not necessarily obey a simple formula, but is is unique and allows extrapolation to temperatures and strain rates outside the range of measurements by interpolation on the reduced diagram. New data are presented for the deformation of pure copper polycrystals. 11 refs., 7 figs.

**34502** (LA-UR–91-2703) **Experimental evaluation of a contact area evolution model.** Korzekwa, D.A. (Los Alamos National Lab., NM (United States)); Dawson, P.R. Los Alamos National Lab., NM (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-911213–8: American Society of Mechanical Engineers (ASME) annual winter meeting, Atlanta, GA (United States), 1-6 Dec 1991). Order Number DE91018037. Source: OSTI; NTIS; GPO Dep.

Experiments designed to simulate boundary lubrication conditions during sheet forming were performed and evaluated. The results are compared to a model for contact area evolution caused by flattening of surface asperities. Microscopic observations and estimates of the area fraction in boundary contact agree reasonably well with the model. The effect of microstructural features on the accuracy of continuum models is also discussed. 8 refs., 15 figs.

**34503** (LA-UR–91-3051) **Synthesis of Al/$Al_3Ti$ two-phase alloys by mechanical alloying.** Srinivasan, S.; Chen, S.R.; Schwarz, R.B. Los Alamos National Lab., NM (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910938–2: International conference on high temperature aluminides and intermetallics, San Diego, CA (United States), 17-19 Sep 1991). Order Number DE92000193. Source: OSTI; NTIS; GPO Dep.

We have mechanically alloyed mixtures of elemental powders to prepare fine-grain two-phase Al/$Al_3Ti$ powders at the compositions Al-20at% Ti and Al-10at% Ti. Hexane was used to prevent agglomeration of the powder during MA. Carbon from the decomposition of the hexane was incorporated in the powder. It reacted with Ti to form a fine dispersion of carbides in the final hot-pressed compact. We consolidated the mechanically alloyed powders by hot-pressing. Yield strength and ductility were measured in compression. At 25°C, the compressive yield strengths were 1.25 and 0.6 GPa for the Al-20at% Ti and Al-10at% Ti alloys, respectively. The ductility of the Al-10at% Ti alloy exceeded 20% for $25 < T < 500$°C. 25 refs., 6 figs.

**34504** (LBL–26928) **Influence of extrinsic crack deflection and delamination mechanisms on the cryogenic toughness of aluminum-lithium alloy 2090: Behavior in plate (T81) vs sheet (T83) material.** Venkateswara Rao, K.T.; Ritchie, R.O. Lawrence Berkeley Lab., CA (United States). Feb 1989. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-8903109–6: 5. international aluminum-lithium conference, Williamsburg, VA (United States), 28-31 Mar 1989). Order Number DE92000927. Source: OSTI; NTIS; GPO Dep.

Cryogenic strength-toughness relationships are examined in 1.6-mm- thick sheet of commercial 2090-T8 aluminum-lithium alloy, and results compared with behavior in 12.7-mm-thick rolled plate. Unlike the significant increase in L-T fracture toughness exhibited by thick place sections at cryogenic temperatures, the thin sheet (of normally similar composition and microstructure) shows a marked decrease in toughness between 298 and 77 K. Such contrasting observations are attributed primarily to the low short-transverse toughness of the 2090-plate material, which results in enhanced through-thickness intergranular splitting during low-temperature fracture and hence to a prominent role of crack-divider delamination toughening. 23 refs., 6 figs., 1 tab.

**34505** (LBL–28244) **On the micromechanisms of fatigue-crack propagation in aluminum- lithium alloys: Sheet vs. plate material.** Rao Venkateswara, K.T. (Lawrence Berkeley Lab., CA (United States)); Ritchie, R.O.; Bucci, R.J. Lawrence Berkeley Lab., CA (United States). Dec 1989. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-900764–4: Fatigue '90: 4th international conference on fatigue and fatigue thresholds, Honolulu, HI (United States), 15-20 Jul 1990). Order Number DE92000926. Source: OSTI; NTIS; GPO Dep.

Micromechanisms influencing the propagation of long (>10 mm) fatigue cracks in aluminum-lithium alloys are examined by specifically comparing crack-growth kinetics in a peak-aged Al-Li-Cu-Zr alloy 2090, processed as 1.6-mm thin (T83) sheet and 12.7-mm thick (T81) plate. It is found that in general crack-growth rates are significantly faster in the sheet material at equivalent stress-intensity levels, due to differences in the role of crack-tip shielding, resulting from crack deflection and consequent crack closure from wedging of fracture-surface asperities. Microstructurally, such differences are related to variations in the degree of recrystallization, grain structure and deformation texture in the two wrought-product forms. 14 refs., 4 figs.

**34506** (LBL–28964) **Development of microstructures with improved cryogenic toughness through local variations in stress state: Aluminum-lithium alloys.** Venkateswara Rao, K.T. (Lawrence Berkeley Lab., CA (United States)); Ritchie, R.O. Lawrence Berkeley Lab., CA (United States). Apr 1990. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-900466–102: Spring meeting of the Materials Research Society (MRS), San Francisco, CA (United States), 16-21 Apr 1990). Order Number DE92000900. Source: OSTI; NTIS; GPO Dep.

Microstructurally-induced changes in the local stress state (triaxial constraint) and their effect on fracture-toughness behavior are examined at ambient and cryogenic temperatures in an Al-Li-Cu-Zr alloy, processed in the form of 12.7 mm-thick "naturally laminated" plate containing aligned-weak interfaces and 1.6 mm-thin unlaminated sheet. It is shown that marked improvements in long-transverse (L-T) toughness can be achieved in the plate material at cryogenic temperatures by promoting through-thickness delamination along these interfaces, which relaxes local constraint and promotes a fracture-mode transition from global plane strain to local plane stress. Conversely, in thin sheet material, the absence of such interface delamination leads to a reduction in toughness with decrease in temperature, consistent with the greater degree of crack-tip constraint. 17 refs., 4 figs., 1 tab.

**34507** (LBL–31008) **Distribution of ion-implanted yttrium in $Cr_2O_3$ scale and in the underlying Ni-25 wt % Cr alloy.** Hou, P.Y. (Lawrence Berkeley Lab., CA (United States)); Brown, I.; Chia, V. Lawrence Berkeley Lab., CA (United States). Jul 1991. 19p. Sponsored by Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC03-76SF00098. (CONF-910707–8: 7. international conference on surface modification of metals by ion beams (SMMIB-7). Washington, DC (United States), 15-19 Jul 1991). Order Number DE92000734. Source: OSTI; NTIS; INIS; GPO Dep.

Implantation of yttrium and other reactive metals has been known to show significant effects on the oxidation behavior of $Cr_2O_3$-forming alloys. The oxide growth rate decreases by nearly a factor of ten, and the adhesion of oxide scales to alloys is greatly improved. To better understand the mechanisms by which these elements affect oxidation, it is important to know whether or not they are present in the metal ahead of the oxide layer. In this study, the diffusivity of implanted yttrium in a Ni-25 wt %Cr alloy and its distribution in the oxide scale after different oxidation times have been evaluated using secondary ion mass spectroscopy. It was found that only 17 ppm of yttrium was left in the alloy after just 20 minutes of oxidation at 1000°C. The implanted Y remained concentrated at the oxide/gas interface as the oxide thickened with time. Within the oxide layer, the Y concentration progressively dropped to zero at the scale/alloy interface. These results are discussed in relation to several important mechanisms proposed for the beneficial effects of reactive element additions on scale adhesion. 17 refs., 5 figs.

**34508** (LBL–31057) **Theory of ordering transformations in metals and minerals.** Lindsey, T.F. (California Univ., Berkeley, CA (United States). Dept. of Materials Science and Mineral Engineering). Lawrence Berkeley Lab., CA (United States). Jul 1991. 107p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000855. Source: OSTI; NTIS; GPO Dep.

This dissertation presents an investigation of ordering in FCC based systems using the pair potential approximation in the ground state and mean field limits. The theoretical approach is used to explain the occurrence of observed equilibrium phases and characteristics of thermodynamic instabilities, in particular, spinodal ordering and decomposition. It is shown that the stability of non-integer domain sizes in long period superstructures such as $Al_3Ti$ and $Ag_3Mg$ may result from the tendency of a system to reduce the number of non-dominant ordering waves, thus producing domain sizes that have rational fraction form n/m. This conclusion is used to explain the domain size stability with respect to variations in temperature and electron concentration. The cation ordering in the precipitate phases in calcite and dolomite is analyzed by analogy with ordering in FCC based metals. The ordered phases in calcite and dolomite are shown to be consistent with pair potential minima at {100} and {1/2, 1/2, 1/2} positions in reciprocal space respectively. 32 refs., 6 figs.

**34509** (LBL–31074) **Pre-tinning and flux considerations on the reliability of solder surface.** Sunwoo, A.J. (Lawrence Livermore National Lab., CA (United States)); Morris, J.W. Jr.; Lucey, G.K. Lawrence Berkeley Lab., CA (United States). Jul 1991. 16p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC03-76SF00098. Contract MIPR No.R91-056. (CONF-9108172–2: Surface Mount International (SMI) conference, San Jose, CA (United States), 27-29 Aug 1991). Order Number DE92000905. Source: OSTI; NTIS; GPO Dep.

The kinetics of wetting were studied on several different prepared surfaces of copper (Cu) to simulate the microstructure observed in pre-tinned Cu-clad printed circuit boards. The results illustrate the effectiveness of pre-tinning in maintaining the solderability of Cu surfaces. Pre-tinning with Pb-rich solder (95Pb-5Sn) is particularly effective since solderability is preserved even after a relatively long aging treatment. On the other hand, pre-tinning with eutectic solder risks the loss of solderability during aging or baking due to surface exposure of an $\varepsilon$-phase intermetallic with poor wetting properties. The results also confirm the presence of carbon in pre-tinned specimens due to the use of flux. The effect of carbon on solderability is not yet known. 13 refs., 8 figs., 1 tab.

**34510** (LBL–31075) **Microstructural influence on the work hardening of aluminum-lithium alloy 2090 at cryogenic temperatures.** Chu, D. (Lawrence Berkeley Lab., CA (United States)); Tseng, C.T.; Morris, J.W. Jr. California Univ., Berkeley, CA (United States). Dept. of Materials Science and Engineering. Jun 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-910635–17: Cryogenic engineering conference and international cryogenic materials conference, Huntsville, AL (United States), 11-14 Jun 1991). Order Number DE92000903. Source: OSTI; NTIS; GPO Dep.

Previous studies indicate that the work hardening characteristics of a Vintage III 2090-T81 12.7-mm (0.5-in.) plate is highly dependent on the through-thickness position. This dependency has been linked to two distinctly different microstructures existing as laminates within the plate. An investigation of the two microstructures by both optical and transmission electron microscopy reveal a difference in the distribution of grains and subgrains. It is believed that these factors affect the work hardening characteristics by governing the manner in which slip is transmitted from grain to grain. The findings are positive as they suggest a practical means by which improvements in work hardening can be obtained through modifications of the microstructure at the polygranular level. 24 refs., 7 figs.

**34511** (LBL–31085) **Cluster expansion of fcc Pd-V intermetallics.** de Fontaine, D. (Lawrence Berkeley Lab., CA (United States)); Wolverton, C.; Ceder, G.; Dreysse, H. Lawrence Berkeley Lab., CA (United States). Jun 1991. 13p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant NATO 0512/88;Grant NSF INT-8815493. (CONF-9106275–3: NATO advanced research workshop, Irsee (Germany), 23-29 Jun 1991). Order Number DE92000842. Source: OSTI; NTIS; GPO Dep.

A cluster expansion is used to compute fcc ground states from first principles for the Pd-V system. Intermetallic structures are not assumed but derived rigorously by minimizing the configurational energy subject to linear constraints. A large number of concentration-independent interactions are calculated by the method of direct configurational averaging. Agreement with the fcc-based portion of the experimentally-determined Pd-V phase diagram is quite satisfactory. 25 refs., 2 figs.

**34512** (MISC–90071) **Spray coating of metals: Phase 1, Feasibility of concept: Interim report.** Ploger, S.A.; Hembree, P.B.; Watson, L.D. EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1990. 169p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC07-76ID01570. (ESL-TR–89-61). Order Number DE91018831. Source: OSTI; NTIS (US Sales Only); GPO Dep.

In response to increasingly stringent environmental regulations, the Idaho National Engineering Laboratory (INEL) is developing a new coating technique to the eliminate hazardous wastes generated by electroplating processes at Air Logistics Centers (ALCs). In this approach, molten metal is sprayed in fine droplets directly onto a base metal, with near-perfect conversion efficiency and without forming any hazardous liquid or airborne wastes. The Phase 1 feasibility study confirmed that a low-melting-point metal can be deposited with excellent adhesion and negligible porosity, while strengthening the coating layer by rapid solidification. One way to minimize hazardous electroplating wastes is to develop an alternative metallization technique that prevents waste generation, rather than attempting to remediate the existing process cycle. The objective of the Spray Coating of Metals project is to investigate coating capabilities of spray-forming technology, whereby molten metals are nebulized into a jet of rapidly cooling droplets that consolidate upon impacting a base metal. Phase 1 goals consisted of designing, building, and successfully operating a bench-scale spray-coating system at low temperatures. This economical feasibility demonstration also required evaluating samples for several aspects of coating quality, plus assessing the prospects for spraying serviceable high-melting-point coatings in future phases.

**34513** (NUREG/GR–0002) **Continuous cooling thermal cycle effects on sensitization in stainless steel.** Atteridge, D.G. (Oregon Graduate Inst. of Science and Technology, Beaverton, OR

(United States). Dept. of Materials Science and Engineering); Cedeno, C.A. Nuclear Regulatory Commission. Washington, DC (United States). Div. of Engineering; Oregon Graduate Inst. of Science and Technology, Beaverton, OR (United States). Dept. of Materials Science and Engineering. Sep 1991. 60p. Sponsored by Nuclear Regulatory Commission, Washington, DC (United States). Grant NRC-G-04-87-105. Source: OSTI; NTIS; GPO.

Work for this study was directed towards quantifying sensitization development (defined as grain boundary chromium depletion) in high carbon Type 304 and 316 stainless steel (SS) subjected to linear heating to a given peak temperature followed by linear cooling through the sensitization development temperature range. The major variables investigated included: (1) heating rate; (2) peak temperature; (3) holding time at peak temperature; and, (4) cooling rate. Change in sensitization was tracked using the electrochemical potentiokinetic reactivation (EPR) test. Continuous heating/cooling cycles were performed using a furnace or using a thermal cycle simulation machine (Gleeble). Sensitization was found to increase with increasing peak temperature until a "critical" peak temperature was reached. Sensitization was very low for all samples heated above this critical peak temperature. The critical peak temperature was 900°C for high-carbon (0.06 wt%) 304 and varied from 950 to 1000°C for high-carbon (0.06 wt%) 316 SS. Sensitization increased with decreasing cooling rate and appeared to decrease with increasing heating rate. The slowest heating rate used was equal to the fastest cooling rate tested. Results are discussed in terms of grain boundary chromium carbide nucleation and precipitation, and chromium depletion. 33 refs., 25 figs., 10 tabs.

**34514** (RFP–4498) **The EDM surface: Topography, chemistry, and metallurgy.** Fuller, J.E. EG and G Rocky Flats, Inc., Golden, CO (United States). [1991]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-9109247–1: Society of Manufacturing Engineers (SME) electric discharge machining (EDM) clinic, Grand Rapids, MI (United States), 17 Sep 1991). Order Number DE91017756. Source: OSTI; NTIS; GPO Dep.

The surface created by the electric discharge machining (EDM) process is of special interest because it has been shown to have a negative effect on the fatigue properties of many alloys. An understanding of the surface metallurgy and chemistry is important in predicting those alloys which are most susceptible to failure. Remedial actions, including thickness minimization, alteration, or removal of the surface layer are addressed.

**34515** (RFP-Trans–507) **Aluminum arc welding method.** Ivanova, O.N. (Ye. O. Paton Electric-Arc Welding Institute (USSR)); Steblovskii, B.A.; Rabkin, D.M.; Budnik, V.P. Rockwell International Corp., Golden, CO (United States). Rocky Flats Plant. Apr 1990. 2p. Translation of Russian Patent No. 332965, March 21, 1972. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91018407. Source: OSTI; NTIS; GPO Dep.

Short communication. ALUMINIUM/arc welding; ALUMINIUM ALLOYS/arc welding; ALUMINIUM; DESIGN; INVENTIONS; GAS FLOW

**34516** (SAND–91-1509C) **Gold sulfide replacements of cyanide solutions.** Worobey, W.; Norwood, D.; Rieger, D. Sandia National Labs., Albuquerque, NM (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109259–1: 1. international congress on environmentally conscious manufacturing, Santa Fe, NM (United States), 18 Sep 1991). Order Number DE91017981. Source: OSTI; NTIS; GPO Dep.

At Sandia National Laboratories we have introduced a non-cyanide gold electroplating solution in the Solid State Circuit Processing Lab. This commercially available solution is based on gold sulfite salts. An evaluation of the plating bath and the deposited gold for use in microelectronic circuit fabrication was conducted. The tests included selective plating compatability, wire bonding, soldering, gold resistivity, adherence, and step coverage. The results were all favorable. Precision gold patterns with line widths as small as 2$\mu$m and gold thickness over 4$\mu$m were selectively plated using a positive photoresist as a plating mask. Also the gold sulfite solution was used to fabricate gold air bridge crossovers for GaAs circuits. The introduction of the non-hazardous sulfite solution for plating high purity gold films will lead to manufacturing processes which are safer to work with and less damaging to the environment.

**34517** (SAND–91-1843C) **Fusion welding of refractory metals.** Robino, C.V. Sandia National Labs., Albuquerque, NM (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911003–12: Fall meeting of the Minerals, Metals and Materials Society of AIME and Materials Week of the American Society of Metals, Cincinnati, OH (United States), 20-24 Oct 1991). Order Number DE91018397. Source: OSTI; NTIS; GPO Dep.

The refractory metals of Groups 5B and 6B and their alloys display a variety of unique physical and mechanical characteristics in addition to their high melting points. In turn, these characteristics make these materials strong candidates for severe service and specialized applications. However, these materials also present a variety of challenges with respect to both fabrication weldability and the in-service behavior of weldments, many of which are related to the dominant effects of interstitial impurities. This work reviews current understanding of the physical and joining metallurgy of these metals and their alloys with emphasis on fusion welding. Of specific interest are the role of impurities and alloy chemistry in fabrication and service weldability, the material processing route, eg. vacuum melting vs. powder metallurgy, the importance of welding process procedures and variables, weldment mechanical properties, and fracture behavior. Specific examples from the various alloy systems are used to illustrate general metallurgical and joining characteristics of this class of materials. 34 refs., 14 figs., 3 tabs.

**34518** (UCRL-JC–107839) **Electroless vs electrodeposited Ni-P alloys for diamond turning applications.** Dini, J.W. Lawrence Livermore National Lab., CA (United States). Jul 1991. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911197–1: Electroless nickel '91, Orlando, FL (United States), 20-22 Nov 1991). Order Number DE91018999. Source: OSTI; NTIS; GPO Dep.

Electrolytes nickel deposits with greater than 10% phosphorous have been widely used for diamond turning applications such as fabrications of large optics and other high precision parts. Although the coatings have worked well, they are not without their drawbacks. Porosity and nodule formation have been problems as well as the difficulty of obtaining deposits greater than about 75 $\mu$m. In recent years much effort has been directed at the investigating electrodeposition of Ni-P alloys in an attempt to avoid these problems. The purpose of this paper is to compare diamond turning results for both electroless and electrodeposited alloys and speculate about the future uses of electrodeposited Ni-P for precision finishing applications. 16 refs., 7 figs.

**34519** (UCRL-TT–106459) **Radiochemical determination of the solubility of sulfur in metals.** Oudar, J.; Barbouth, N. Lawrence Livermore National Lab., CA (United States). 5 Feb 1991. 8p. Translated from Bulletin de la Societe Chimique de France (France); No. 3, 834-836(1970). Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018410. Source: OSTI; NTIS; GPO Dep.

This method is based on the use of radioactive sulfur and class for prior calibration of the sulfur used and determination of the beta radiation absorption of sulfur 35 for the metal considered. This method was first used during a study of the solubility of sulfur in copper. We will describe the method in detail and show how it applies to assaying sulfur in numerous metals. It's based essentially on the use of $^{35}S$ labeled sulfur, emitting beta radiation (energy = 0.167 Mev). A calibration is required first to establish the relation between a predetermined quantity of this element distributed in a thin layer on the surface of a metal and its activity measured by a suitable counting device. 6 refs., 4 figs., 1 tab.

**34520** (UCRL-TT–107146) **On the formation of a joint during cold welding.** Meriin, B.V. Lawrence Livermore National Lab., CA (United States). 29 Apr 1991. 10p. Translated from Fizika i Kkhimiya Obrabotki Materialov (USSR); No. 6, 125-129(1968). Sponsored by USDOE, Washington, DC (United States). DOE

Contract W-7405-ENG-48. Order Number DE91017672. Source: OSTI; NTIS; GPO Dep.

Materials from an experimental study of the process of formation of a workable joint during cold welding are given. An interpretation of the experiment results are presented. It is very useful to study the processes of formation of a joint during cold welding on the example of a butt joint. Butt welding makes it possible to obtain joints in a wide range of deformations (the basic technological parameter of cold welding). The previously developed technique of mechanical testing of butt joints assures the joint will fail through the zone of the butt, which makes it possible to evaluate the strength and plasticity of the metal of the weld zone, to identify welding defects and to analyze the fractures. The tests were carried out on samples of AMts aluminum alloy $\phi$20 mm, copper $\phi$16 mm and copper with aluminum $\phi$20 mm, which were butt welded on an MSKhS-80 machine. Clamp jaws with sharpened end surfaces, which cut the metal forced out into a flash, were used. Welding was done in lots in regimes with increasing deformation, which was determined by the relative throat, h/d where h is the size of the deformable throat and d is the diameter of the sample being welded. 11 refs., 4 figs.

## 3602 Ceramics, Cermets, and Refractories

*Refer also to citation(s) 33559, 33975, 34420, 34430, 34431, 34449, 34500, 34850, 35174, 35433, 35434, 35439*

**34521** (ALS/TR–90-021) **Sintered compacts for heat sinks and process for fabricating same.** Hara, Akio (Sumitomo Electric Industries Ltd., Osaka (Japan)); Yatsu, Shuji. Sandia National Labs., Albuquerque, NM (United States). Nov 1990. 8p. Translation of Japanese Patent Application No. 32,154, 1987. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91018438. Source: OSTI; NTIS; GPO Dep.

The present invention relates to sintered compacts for heat sinks and to a process for fabricating same. Over the past few years, the semiconductor devices employed in high-field and high-current density [applications] have been adopted for practical use. Because power consumption density is especially high in the active regions of semiconductor lasers and IMPATT devices, for example, the amount of heat generated by the device is large, necessitating modifications that prevent temperature rises in the devices. As a result, much attention has been devoted to materials which have a high thermal conductivity and are capable of serving as heat sinks.

**34522** (ANL/CP–72064) **Strengthening of composites by internal stresses: Determination by neutron diffraction.** Singh, J.P.; Kupperman, D.S.; Majumdar, S. Argonne National Lab., IL (United States). Aug 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-911084–3: International symposium on ceramics, Yokohama (Japan), 16-18 Oct 1991). Order Number DE91018549. Source: OSTI; NTIS; GPO Dep.

The bulk internal stresses in the constituents of two composites (Ag particulate dispersed $YBa_2Cu_3O_x$ superconductors and SiC-whisker-reinforced $AL_2O_3$ matrix) were measured by neutron diffraction technique. For $YBa_2Cu_3O_x$-Ag composites, the tensile strain in the Ag phase was as high as 0.085%, while compressive strain in the $YBa_2Cu_3O_x$ phase was as high as 0.09%. The presence of compressive strain resulted in improvement in strength of YBCO superconductors from 200 to 223 MPa. The internal strains in $Al_2O_3$-SiC composites were observed to relax with temperature extrapolating to zero value at ~1350°C. 19 refs., 3 figs.

**34523** (ANL/CP–73491) **Anisotropic shift of the irreversibility line by neutron irradiation.** Sauerzopf, F.M. (Atominstitut der Oesterreichischen Universitaeten, Vienna (Austria)); Wiesinger, H.P.; Weber, H.W.; Crabtree, G.W.; Frischherz, M.C.; Kirk, M.A. Argonne National Lab., IL (United States). Sep 1991. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910710–4: 6. international workshop on critical currents in superconductors (IWCCVI), Cambridge (United Kingdom), 7-12 Jul 1991). Order Number DE92000361. Source: OSTI; NTIS; INIS; GPO Dep.

The irreversibility line of high-$T_c$superconductors is shifted considerably by irradiating the material with fast neutrons. The anisotropic and non-monotonous shift is qualitatively explained by a simple model based on an interaction between three pinning mechanisms, the intrinsic pinning by the ab-planes, the weak pinning by the pre-irradiation defect structure, and strong pinning by neutron induced defect cascades. A correlation between the cascade density and the position of the irreversibility line is observed.

**34524** (ANL/CP–73957) **Chemical thermodynamic equilibria and conductivity of nonstoichiometric $YB_2Cu_3O_{7-\delta}$: A review.** Thorn, R.J. Argonne National Lab., IL (United States). [1991]. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910855–1: NATO Advanced Study Institute on surfaces and interfaces, Neos Marmaras (Greece), 18-30 Aug 1991). Order Number DE91018638. Source: OSTI; NTIS; GPO Dep.

To synthesize a comprehensive understanding of the nonstoichiometric phase, $YBa_2Cu_3O_{7-\delta}$, the following topics are discussed: (1) The chemical equilibria involved in nonstoichiometric $YBa_2Cu_3O_{7-\delta}$ derived principally from photoelectron spectroscopic observations. (2) Nonstoichiometry: Experimental values of the variation of the partial pressure of oxygen with temperature and composition are rationalized quantitatively in terms of nearest neighbor lattice statistics. Energies of interaction between oxygens in the basal plane are obtained. (3) The structures of the variation of conductivity with temperature and composition are interpreted quantitatively in terms of a model with a narrow conduction band and a small gap, thermally activated valence band. (4) Optical conductivity derived from reflectance; structures of $\sigma(T,\omega)$. The quantitative studies of these topics lead to the conclusion that small polarons exist in $YBa_2Cu_3O_{7-\delta}$ and are the source of the conductivity. This conclusion implies that the superconducting state is bipolaronic. 62 refs., 20 figs., 2 tabs.

**34525** (CONF-910617–4) **Mechanical properties and microstructure of pressureless sintered duophase sialon.** Lee, Ran-Rong (Ceramics Process Systems Corp., Milford, MA (United States)); Novich, B.E.; Franks, G.; Quellette, D.; Ferber, M.K.; Hubbard, C.R.; More, K. Oak Ridge National Lab., TN (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 4. international symposium on ceramic materials and components for engines; Goeteborg (Sweden); 10-12 Jun 1991. Order Number DE92000043. Source: OSTI; NTIS; GPO Dep.

Duophase ($\alpha'/\beta'$) sialon is being developed for ceramic engine applications by using the Quickset™ injection molding process, followed by pressureless sintering and a thermal treatment. The sialon had an average four-point flexural strength of 670 MPa at room temperature and 490 MPa at 1370°C. It survived the flexural stress rupture test at 1300°C and 340 MPa for 190 hours. X-ray diffraction (XRD) and transmission electron microscopy (TEM) characterization showed that crystallization of the grain boundary phase improved the high temperature flexural strength of this sialon material. The creep behavior was also found to be affected by the crystallized grain boundary phases. The formation of a yttrium aluminum garnet (YAG) phase and elongated grains yielded better creep resistance. The correlation between mechanical properties and microstructure is discussed. 13 refs., 7 figs.

**34526** (CONF-910860–2) **Magnetization studies of irradiation modified single crystal $Y_1Ba_2Cu_3O_7$ superconductors: Flux creep and annealing effects.** Thompson, J.R. (Oak Ridge National Lab., TN (United States)); Yang, Ren Sun; Christen, D.K.; Kerchner, H.R.; Malozemoff, A.P.; Civale, L.; Marwick, A.D.; Worthington, T.K.; Krusin-Elbaum, L. Oak Ridge National Lab., TN (United States). [1991]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From NATO Advanced Study Institute on physics and materials science of high-temperature superconductors; Corfu Island (Greece); 18-31 Aug 1991. Order Number DE91018858. Source: OSTI; NTIS; GPO Dep.

Measurements of the static magnetization of a superconductor provide an informative and facile method to understand many of its properties. The objective of this paper is to analyze several features of the high temperature superconductor $Y_1Ba_2Cu_3O_7$, hereafter referred to as YBCO. Of particular interest are the critical

current density, which is related to irreversibility in the magnetization, and the effects of different types of defects in the material. These defects tend to "pin" or immobilize the quantized magnetic field lines (vortices) that permeate a Type-2 superconductor when it is immersed in a magnetic field H that is greater than the lower critical field $H_{c1}$. This process is dramatically affected by the presence of "giant flux creep," a pervasive feature of high temperature superconductors. In this work, high quality single crystals of $Y_1Ba_2Cu_3O_7$, with $T_c$ values >90 K, were studied in three forms: (1) as synthesized, with relatively low critical current density $J_c$; (2) after irradiation with light ions (protons with 3 MeV energy), that created point defects and increased $J_c$ considerably; and (3) after irradiation with heavy ions (Sn-ions with 580 MeV energy) that created linear pinning defects parallel to the ion paths. We discuss first the irreversible vortex-state magnetization, the related critical current density $J_c$, relaxation of the magnetization with time ("flux creep"), the dependence of pinning energy on the magnitude of current density J, long-term studies of magnetic relaxation and their relation to collective pinning models, and finally treat "flux creep annealing" experiments. Where possible, we compare and contrast the results achieved with point-like and linear flux pinning geometries. 31 refs., 17 figs.

**34527** (CONF-9109102–1) **Properties of epitaxial $YBa_2Cu_3O_{7-\delta}$-based superconducting superlattices.** Norton, D.P. (Oak Ridge National Lab., TN (United States)); Lowndes, D.H.; Zheng, Z.Y.; Feenstra, R.; Zhu, Shen. Oak Ridge National Lab., TN (United States). Sep 1991. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 5. annual conference on superconductivity and applications; Buffalo, NY (United States); 24-26 Sep 1991. Order Number DE92000423. Source: OSTI; NTIS; GPO Dep.

Epitaxial $YBa_2Cu_3O_{7-\delta}$ superconducting superlattices have been fabricated using pulsed laser deposition in which c-axis oriented $YBa_2Cu_3O_{7-\delta}$ layers as thin as one unit cell thick are separated by relatively thick $PrBa_2Cu_3O_{7-\delta}$ based barrier layers. The superlattice $T_c$(R=0) decreases rapidly with increasing barrier layer thickness, but then saturates at a finite $T_c$ for $YBa_2Cu_3O_{7-\delta}$ layers as thin as a single c-axis unit cell. The superconducting properties of $YBa_2Cu_3O_{7-\delta}$-based superlattices are shown to depend strongly on the electronic properties of the barrier layers. The resistive transition width decreases significantly as the hole carrier density in the barrier layers is increased. However, $T_c$(onset) does not change, contrary to predictions of hole filling models. Theoretical analyses suggest that the broadening of the resistive transition for the thinnest $YBa_2Cu_3O_{7-\delta}$ layers is most likely due to a crossover to 2D resistive behavior involving thermally-generated vortices. Scanning tunneling microscopy reveals that epitaxial $YBa_2Cu_3O_{7-\delta}$ thin films grow unit cell-by-unit cell, by a terraced-island growth mode. This terraced microstructure explains the steps found in ultrathin $YBa_2Cu_3O_{7-\delta}$ layers in these superlattices. These steps may act as superconducting weak links, providing support for 2D Josephson-coupled-array models of superconducting superlattices. 34 refs., 5 figs.

**34528** (CONF-9109286–1) **Laser ablation synthesis and properties of epitaxial $YBa_2Cu_3O_{7-\delta}$/$PrBa_2Cu_3O_{7-\delta}$ superconducting superlattices.** Lowndes, D.H. (Oak Ridge National Lab., TN (United States)); Norton, D.P.; Zheng, X.Y.; Zhu, Shen. Oak Ridge National Lab., TN (United States). Sep 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From European Materials Research Society (E-MRS) summer school on laser ablation of electronic materials: basic mechanisms and applications; Carcans-Maubuisson (France); 16-19 Sep 1991. Order Number DE92000447. Source: OSTI; NTIS; GPO Dep.

Pulsed laser ablation has been used to fabricate epitaxial superlattices in which c-axis-perpendicular $YBa_2Cu_3O_{7-\delta}$ (YBCO) layers as thin as a single unit cell are separated by semiconducting $PrBa_2Cu_3O_{7-\delta}$ (PBCO) layers. The superlattice $T_c$(R=0) decreases rapidly with increasing PBCO thickness, but then saturates at $T_c$~19 K, 54 K, 71 K, or 80 K, for structures containing isolated, 1-,2-,3-, or 4-cell-thick YBCO layers, respectively. Recent theoretical analyses suggest that the decrease of $T_c$ and broadening of the resistive transition for the thinnest YBCO layers is most likely due either to a crossover from 3D to 2D resistive behavior, or to hole-filling in the YBCO layers caused by electron transfer from the PBCO. We find that the resistance in the superconducting transition region scales with temperature as expected for dissipation by characteristically 2D (vortex) excitations. Departures from the "universal" resistance behavior expected for a 2D Ginzburg-Landau Coulomb gas, as the YBCO thickness is increased or the PBCO thickness is decreased, can be attributed to the onset of phase coupling between the YBCO layers. Thus, the experiments show that YBCO's effective anisotropy can be greatly increased by separating very thin YBCO layers by thicker PBCO layers in superlattice structures. As a results, characteristic 2D dissipation can be observed over a greatly expanded temperature range, relative to both thicker-film and single-crystal YBCO specimens. Experiments also were carried out using two additional isostructural sets of superlattices in which the PBCO layers were replaced by more conductive Y- or Ca-doped PBCO layers, in order to alter any electron transfer from PBCO to YBCO.

**34529** (DOE/PC/79921–T9) **Pore structure and reactivity changes in hot coal gas desulfurization sobents: Technical progress report, July–September 1990.** Sotirchos, S.V. Rochester Univ., NY (United States). Dept. of Chemical Engineering. Oct 1990. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-87PC79921. Order Number DE91013897. Source: OSTI; NTIS; GPO Dep.

The primary objective of the project is the investigation of the structural and reactivity changes occurring in metal/metal oxide sorbents used for desulfurization of hot coal gas during sulfidation and regeneration, with particular emphasis placed on the effects of these changes on the sorptive capacity and efficiency of the sorbents. This quarter a pulse chromatographic apparatus was used to measure effective diffusivities in fresh and partially reacted samples calcium oxide sorbents obtained through calcination of limestone precursors. For ensuring uniform calcination and being able to produce large quantities of the solid sample, a fluidized-bed reactor was set up. Calcines from two limestones were used to carry out diffusivity measurements: from a limestone of very high CaCO content and from a calcitic marble. Preliminary analysis showed that the resistance for mass transport in the calcines is strongly influenced not only by the pore size distribution but the connectivity of the pores of the solid as well. The latter appears to be strongly dependent upon the mineralogical properties of the precursor limestone and the calcination conditions. A more detailed analysis of the results for diffusion in calcium oxide sorbents is currently carried out using flux models developed by my research group in past studies. We are also working on the measurement of effective diffusion coefficients in fresh and partially sulfided zinc oxide sorbents, C7-2 and G-72D sorbents of United Catalysts. 10 refs., 5 figs.

**34530** (ENEA-RTI-INN–91-11) **Zirconium oxide materials: Microstructural and mechanical characterization.** Filacchioni, G.; Pilloni, L. ENEA, Casaccia (Italy). Area Energia e Innovazione. 1991. 38p. (In Italian). (RTI-INN–91-11). Order Number DE92705888. Source: OSTI; NTIS (US Sales Only).

Due to its discrete rupture modulus, high impact strength, and abrasion resistance, yttrium oxide stabilized ZnO2 is presently of great interest to ENEA (Italian Commission for Nuclear and Alternative Energy Sources) researchers working on MHD electrode thermal barriers. This paper describes the materials testing of ZnO2 samples prepared (pressed/sinterized) by different methods - starting with partially yttrium stabilized, commercially available (from TOSOH Corp.) zirconium powders, and Gel-Supported Process (GSP) powders developed at the TEMAV labs. In particular, the paper reports the results of flexure tests at 850 degrees C with a MAYES, ESM, electromechanical frame. Graphs report rupture probability versus modulus of rupture and Young's modulus versus temperature for the different makes. A follow-up discussion of the influence of preparation methods on microstructure and toughness is based on observations made with a high resolution, JEOL 4000FX microscope equipped with an EDS TRACOR system for thin film microanalysis, and an Electron Energy Loss Spectrometer, EELS.

**34531** (FhG-IWM-W–8/90) **Experimental investigation of the influence of crack fields on mechanical and fracture-mechanical quantities. Final report.** Schoenholz, R.: Kleer, G.; Doell, W. Fraunhofer-Institut fuer Werkstoffmechanik, Freiburg im Breisgau (Germany); Deutsche Forschungsgemeinschaft, Bonn (Germany). Jun 1990. 25p. (In German). Contract DFG Do 214/8-3. Order Number DE92714269. Source: OSTI; NTIS (US Sales Only); INIS.

The description of strength behavior and failure behavior of ceramics by means of fracture-mechanical data was based up to now mainly on data obtained for the propagation behavior of single cracks in a material defined otherwise as crack-free. It turned out that in case of failure processes dominated by the single crack event one also has to take into account cracks already existing in the material. An effect of main importance behind the crack tip is discussed first, namely R-curve effect due to crack edge interaction. Furthermore, an effect which essentially considers interaction between main crack and microcracks in the range of the crack tip in the so-called process region has to be considered. This problem was examined experimentally and in theory. The work reported here examined the strength of pre-damaged test pieces and the influence of different crack configurations, which are pre-set by macrocracks and different microcrack fields, on the crack resistance behavior, i.e. on displacement of the $K_I$-intervals in the double torsional test. (orig.) With 3 tabs., 12 figs., 7 refs.

**34532** (INIS-SU–266, pp. 104) **Study of paramagnetic defects in irradiated aluminium oxides of various modifications.** Voloshenko, L.A. (Tomskij Politekhnicheskij Inst., Tomsk (USSR)); Serikov, L.V.; Shiyan, L.N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ALUMINIUM OXIDES/phase studies; ALUMINIUM OXIDES/physical radiation effects; CRYSTAL DEFECTS; CRYSTAL LATTICES; ELECTRON SPIN RESONANCE; LOW TEMPERATURE; SPECTRA

**34533** (INIS-SU–266, pp. 126) **On phase transformation in silicon dioxide under reactor radiation.** Ermatov, S.E. (Kazakhskij Pedagogicheskij Inst., Alma-Ata (USSR)). AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. SILICON OXIDES/phase transformations; SILICON OXIDES/physical radiation effects; COPPER ADDITIONS; DIFFUSION; DOSE-RESPONSE RELATIONSHIPS; FLUX DENSITY; IRON ADDITIONS; MICROHARDNESS; NEUTRON FLUX

**34534** (INIS-SU–266, pp. 163) **Ferrite ceramics sintering under irradiation.** Surzhikov, A.P. (Tomskij Politekhnicheskij Inst., Tomsk (USSR)); Kozhemyakin, V.A.; Mojzes, B.B.; Pritulov, A.M.; Voronin, A.P. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. FERRITES/physical radiation effects; FERRITES/sintering; CERAMICS; ELECTRONS; FERRITES; SINTERING; MASS TRANSFER

**34535** (INIS-SU–276, pp. 72) **Investigation of ceramic high-temperature superconductors of Bi-Sr-Ca-Cu-O-F system.** Buznik, V.M.; Volkov, V.E.; Livshits, A.I.; Fokina, N.P. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. HIGH-TC SUPERCONDUCTORS/crystal structure; STRONTIUM COMPOUNDS/high-tc superconductors; BISMUTH COMPOUNDS; CALCIUM COMPOUNDS; CERAMICS; CHEMICAL COMPOSITION; COPPER COMPOUNDS; NMR SPECTRA; OXYFLUORIDES; PHASE STUDIES

**34536** (INIS-SU–276, pp. 117) **Influence of rare earth fluorides on structure formation in fluorozirconate glasses.** Gur'ev, N.V.; Zhmyreva, I.A.; Kolobkov, V.P.; Leskova, M.L.; Petronskij, G.T. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. GLASS/chemical bonds; GLASS/electronic structure; ABSORPTION SPECTRA; ALUMINIUM FLUORIDES; BARIUM FLUORIDES; ELECTRON SPECTRA; ERBIUM FLUORIDES; GLASS; LANTHANUM FLUORIDES; TERBIUM FLUORIDES; ZIRCONIUM FLUORIDES

**34537** (KFK–4843) **KfK Institute of Nuclear Solid State Physics. Progress report on research and development activities in 1990.** Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Festkoerperphysik. Mar 1991. 25p. (In German). Order Number DE92711441. Source: OSTI; NTIS (US Sales Only); INIS.

The INFP is primarily occupied with basic research work in the field of solid state physics and materials science, with preference being given to subjects and problems of interest from the point of view of potential applications. This is particularly true for research work devoted to the high-temperature superconductors, which currently are the area of main effort of the Institute, but also for work performed in the fields of interface and microstructure research, polymer physics, or studies on amorphous and glassy materials. In 1990, about 70% of the activities were superconductivity research. Basic research investigated the lattice dynamics and electronic structure of HT superconductors by means of inelastic neutron scattering, or electron energy loss spectroscopy and tunnel spectroscopy. Application-oriented work concentrated on the development of HTSC-films required for equipment in microwave engineering, microelectronics, and sensor engineering. (orig./MM).

**34538** (KFK–4874) **Development of a tensile creep apparatus for advanced ceramics and tensile creep investigations of silicon nitride materials.** Guertler, M. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Maschinenbau. May 1991. 132p. (In German). Order Number DE92711302. Source: OSTI; NTIS (US Sales Only); INIS.

The critical components of the developed tensile creep concept for temperatures up to 1400deg C are described, i.e. geometry of the test pieces, gripping and aligning system and the high temperature extensometer. Misalignment of less than 5% can be achieved. The creep behaviour of two sintered $Si_3N_4$-materials is studied. One material contains $Y_2O_3$ and MgO as sintering additives and the second $Yb_2O_3$. Whereas the first material shows crystalline as well as amorphous grain boundary phases, the Yb-containing material is to a large extension crystalline. Both materials exhibit high nonlinear stress dependencies of the minimal

creep rates, which can be assigned to different creep mechanisms. For the material containing an amorphous grain boundary phase the change of the composition of the glassy phase leads to extended transient creep ranges. The dependency of the minimal creep rate on the annealing time suggests a time independent analysis of the primary creep behaviour to determine the stress and temperature dependency of the creep rates. The static fatigue behaviour of both materials can be described as a superposition of creep rupture and fracture by slow crack growth. Tensile and bending creep results are compared indicating clearly the stress relaxation effect which occurs in bending. (orig./MM).

**34539** (KFK–4881) **Anharmonic lattice interaction and structural phase transition of the high-temperature superconductor $La_{2-x}Sr_xCuO_4$.** Heid, R. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Festkoerperphysik; Karlsruhe Univ. (T.H.) (Germany). Fakultaet fuer Physik. Jul 1991. 109p. (In German). Order Number DE92711542. Source: OSTI; NTIS (US Sales Only).

This thesis deals with the interrelation of the lattice anharmonicity and the structural phase transition of the high-temperature superconductor $La_{2-x}Sr_xCuO_4$ and with their relevance for the mechanism of superconductivity. In the first part, the influence of the anharmonic lattice interaction on the electron-phonon coupling is studied. The contribution to the electron-phonon coupling constant which is based on the two-phonon exchange diagram of the electron self-energy is shown to be negligible in comparison with the one-phonon exchange contribution. This result implies that anharmonicity which can be handled by perturbation theory does not require a significant modification of the Eliashberg theory. The second part of this work is devoted to the construction of a quantitative model of the anharmonic interaction in $La_2CuO_4$. It is based on the theory of the weakly anharmonic crystal and uses a parameterization for the nonharmonic parts of the short-ranged interatomic potentials. In addition, this approach allows the description of several observables related to the tetragonal-to-orthorhombic phase transition of this compound. (orig.).

**34540** (LBL–29284) **Theoretical modeling and experimental characterization of planar defects in $Y_2Ba_4Cu_{6+x}O_{14+x}$.** Burmester, C.P. (Lawrence Berkeley Lab., CA (United States)); Fendorf, M.; Gronsky, R.; Wille, L.T. Lawrence Berkeley Lab., CA (United States). Nov 1990. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF000098. (CONF-901105–130: Fall meeting of the Materials Research Society (MRS), Boston, MA (United States), 24 Nov - 1 dec 1990). Order Number DE92000898. Source: OSTI; NTIS; GPO Dep.

Crystallographic defects and phase transformations in the system $Y_2Ba_4Cu_{6+x}O_{14+x}(0 \leq x \leq 4)$ are investigated by high resolution transmission electron microscopy (TEM) and static lattice, three dimensional Monte Carlo computer simulations. High resolution images of partially transformed (x = 2 to x = 1) material reveal a prevalence of CuO planar defects (stacking faults) associated with the transformation and an absence of disturbance to the perovskite Ba-Y-Ba blocks. An atomic mechanism involving the intercalculation and removal of extra CuO planes by partial dislocation climb, and requiring only a-b plane diffusion, is developed for the formation of such planar defects during changes in the layered YBaCuO crystal structure. Monte Carlo simulations based on the proposed transformation mechanism accurately reproduce the observed defects and known equilibrium structures. 24 refs., 4 figs.

**34541** (LBL–30928) **Non-stoichiometric defects in YBaCuO thin films.** Fendorf, M. (Lawrence Berkeley Lab., CA (United States)); Tidjani, M.; Burmester, C.; Gronsky, R.; Wille, L. Lawrence Berkeley Lab., CA (United States). Apr 1991. 6p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); Houston Univ., TX (United States). DOE Contract AC03-76SF00098. Grant MDA972-88-J-1002. (CONF-910580–5: International conference on advanced materials (ICAM 91), Strasbourg (France), 27-31 May 1991). Order Number DE92000954. Source: OSTI; NTIS; GPO Dep.

Defects in superconducting YBaCuO thin films deposited by laser ablation are investigated by high resolution transmission electron microscopy. Micrographs reveal numerous defects in the YBaCuO film, falling into four basic classes. One of these is an interesting, non-stoichiometric helical defect structure which possibly corresponds to a growth-related screw dislocation. In general, defects in the YBaCuO film are associated both with growth geometry and with local deviations in stoichiometry. Substrate surface geometry is seen to have a profound effect on the number and type of defects produced. Simulation of annealing transformations using a static lattice, three dimensional, Monte Carlo technique is carried out to gain further insight into specific defect formation mechanisms. The results of these studies suggest preparation conditions that are expected to lead to films with improved critical current densities. 17 refs., 6 figs.

**34542** (LBL–30948) **Crystal structure of stage 1 iodine intercalated superconducting $IBi_2Sr_2CaCu_2O_x$.** Kijima, N.; Gronsky, R.; Xiang, X.; Vareka, W.; Zettl, A.; Corkill, J.; Cohen, M. Lawrence Berkeley Lab., CA (United States). Jul 1991. 24p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant DMR88-18404. (CONF-911202–1: Annual fall meeting of the Materials Research Society, Boston, MA (United States), 2-6 Dec 1991). Order Number DE92000849. Source: OSTI; NTIS; GPO Dep.

The crystal structure of stage-1 iodine-intercalated superconducting $IBi_2Sr_2CaCu_2O_x$ has been determined by transmission electron microscopy to belong to the superspace group $C_{\bar{1}1\bar{1}}^{Pma2}$ with subcell lattice parameters a = 5.4 Å, b = 5.4 Å, c = 18.8 Å, and a structural modulation wavelength of 26 Å. Intercalated iodine atoms alter the atomic stacking across Bi-O layers from the staggered configuration characteristic of superconducting $Bi_2Sr_2CaCu_2O_x$ to a vertically aligned configuration in $IBi_2Sr_2CaCu_2O_x$. From the atomic spacings apparent in the images, it is concluded that the iodine layers bond to their neighboring Bi-O layers by van der Waals interactions. 9 refs., 8 figs., 2 tabs.

**34543** (LBL–31086) **Energetics and statistics of order in alloys with application to oxide superconductors.** de Fontaine, D. (Lawrence Livermore National Lab., CA (United States)); Ceder, G.; Asta, M. Lawrence Livermore National Lab., CA (United States). Jun 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9107179–1: European workshop on ordering and disordering, Grenoble (France), 10-12 Jul 1991). Order Number DE92000851. Source: OSTI; NTIS; GPO Dep.

Now that first-principles calculations of ordering transformations are becoming increasingly accurate, the deficiencies of earlier mean field methods are becoming increasingly apparent. New techniques, based on cluster expansions, are now alleviating many of the earlier problems and are producing very satisfactory results. These ideas will be illustrated for the case of oxygen ordering in the $YBa_2Cu_3O_z$ superconducting compound, for which a very simple two-dimensional Ising model has been developed. The model features nearest-neighbor repulsive effective pair interactions and anisotropic (attractive/repulsive) next-nearest-neighbor interactions. CVM (cluster variation method) calculations based on this model have produced a phase diagram in remarkable agreement with experimentally determined phase boundaries. Monte Carlo simulations have confirmed the validity of the model and have provided a rationalization for the influence of oxygen order on the value of $T_c$(superconducting transition temperature) in off-stoichiometric compounds. 46 refs., 4 figs.

**34544** (LBL–31223) **Design, microstructure, and high-temperature behavior of silicon nitride sintered with rate-earth oxides.** Ciniculk, M.K. (California Univ., Berkeley, CA (United States). Dept. of Materials Science and Mineral Engineering). Lawrence Berkeley Lab., CA (United States). Aug 1991. 147p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. DMR 83-1317239. Order Number DE92000815. Source: OSTI; NTIS; GPO Dep.

The processing-microstructure-property relations of silicon nitride ceramics sintered with rare-earth oxide additives have been investigated with the aim of improving their high-temperature behavior. The additions of the oxides of Y, Sm, Gd, Dy, Er, or Yb were compositionally controlled to tailor the intergranular phase. The resulting

microstructure consisted of $\beta$-$Si_3N_4$ grains and a crystalline secondary phase of $RE_2Si_2O_7$, with a thin residual amorphous phase present at grain boundaries. The lanthanide oxides were found to be as effective as $Y_2O_3$ in densifying $Si_3N_4$, resulting in identical microstructures. The crystallization behavior of all six disilicates was similar, characterized by a limited nucleation and rapid growth mechanism resulting in large single crystals. Complete crystallization of the intergranular phase was obtained with the exception of a residual amorphous, observed at interfaces and believed to be rich in impurities, the cause of incomplete devitrification. The low resistance to oxidation of these materials was attributed to the minimization of amorphous phases via devitrification to disilicates, compatible with $SiO_2$, the oxidation product of $Si_3N_4$. The strength retention of these materials at 1300°C was found to be between 80% and 91% of room-temperature strength, due to crystallization of the secondary phase and a residual but refractory amorphous grain-boundary phase. The creep behavior was found to be strongly dependent on residual amorphous phase viscosity as well as on the oxidation behavior, as evidenced by the nonsteady-state creep rates of all materials. 122 refs., 51 figs., 12 tabs.

**34545** (ORNL/tr–91/29) **Optimizing of selected ceramic, high-temperature materials with regard to strength, fatigue and surface condition.** Pfeiffer, W. (Fraunhofer-institut fuer werkstoffmechanik, Woehlerstr. 11, 7800 Freiburg (DE)); Berweiler, W.; Hollestein, T. Oak Ridge National Lab., TN (United States). Jul 1990. 215p. Translation source information not available. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91018514. Source: OSTI; NTIS; GPO Dep.

This report discusses the influence of processing on the strength and fatigue properties of several high-temperature ceramics. Among the ceramics explored are silicon nitride, silicon carbide, aluminium oxide and zirconium oxides.

**34546** (PNL-SA–16927) **Vickers microindentation toughness of a sintered SiC in the median-crack regime.** Ghosh, Asish (Washington Univ., Seattle, WA (United States). Coll. of Engineering); Kobayashi, A.S.; Li, Zhuang; Henager, C.H. Jr.; Bradt, R.C. Pacific Northwest Lab., Richland, WA (United States). [1991]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000225. Source: OSTI; NTIS; GPO Dep.

The Vickers microindentation method for the determination of the fracture toughness of ceramics was investigated in the median crack regime for a sintered alpha SiC. The results are compared with fracture toughness measurements by conventional fracture mechanics technique and also with the reported indentation toughness for the low-load Palmqvist crack regime. Indentation toughnesses in the median crack regime vary widely depending on the choice of the specific equation which is applied. The indentation toughnesses are also load (crack length) dependent. A decreasing R-curve trend results, in contradiction to the flat R-curve that has been observed with conventional fracture mechanics techniques. It is concluded that the Vickers microindentation method is not a reliable technique for the determination of the fracture toughness of ceramics in the median crack regime.

**34547** (UCRL-ID–107225) **Effects of oxide layers on optical properties and x-ray hardness of Al-Be mirrors.** White, R.H.; Wirtenson, G.R. Lawrence Livermore National Lab., CA (United States). 11 Jun 1991. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000476. Source: OSTI; NTIS; GPO Dep.

Oxide layers form on the surfaces of many metallic mirrors. The oxidation may occur during fabrication or after the mirror is finished and installed. Some oxide layers may be intentionally added to protect the mirror or to change its optical properties. Computer calculations predict the effect of oxide layers on optical and ultraviolet reflectance as well as the x-ray absorption and concomitant thermal damage to the mirrors. 6 refs., 6 figs., 1 tab.

## 3606 Other Materials

*Refer also to citation(s) 33563, 33654, 33735, 33796, 33866, 33973, 33975, 34011, 34012, 34207, 34224, 34280, 34281, 34339, 34376, 34430, 34431, 34439, 34500, 34508, 34537, 34602, 34609, 34701, 34716, 34732, 34835, 34841, 34849, 34851, 34852, 34911, 34947, 34953, 34966, 34974, 34978, 35106*

**34548** (ANL/CP–73443) **Dynamics of vitreous and molten zinc chloride.** Price, D.L. (Argonne National Lab., IL (United States)); Saboungi, M.L.; Susman, S.; Volin, K.J.; Wright, A.C. Argonne National Lab., IL (United States). Sep 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9109103–3: 5. international conference on the structure of non-crystalline materials, Sendai (Japan), 2-6 Sep 1991). Order Number DE92000362. Source: OSTI; NTIS; GPO Dep.

The dynamics of vitreous and molten zinc chloride have been studied with inelastic neutron scattering at the Intense Pulsed Neutron Source. The results are analyzed in terms of the scattering function S(Q,E) and the effective vibrational density of states G(E). The vibrational spectra of both glass and liquid are dominated by broad features centered at 15 and 35 MeV which are identified with $F_2$ modes of $ZnCl_4^{2-}$ tetrahedra. The other two normal modes are not observed because of inadequate resolution and broadening and overlap resulting from coupling between tetrahedra. The behavior of $ZnCl_2$ is contrasted with other tetrahedrally coordinated glasses that have been studied with the same technique. 15 refs,. 5 figs., 1 tab.

**34549** (CONF-910874–2) **On the nature of bulk electrical relaxation in silicate glasses.** Lee, W.K. (Columbia Univ., New York, NY (United States). School of Mines); Aronson-Unger, S.; Liu, J.F.; Nowick, A.S.; Jain, H. Columbia Univ., New York, NY (United States). School of Mines. [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER45341. From 7. international conference on the physics of non-crystalline solids; Cambridge, MA (United States); 4-9 Aug 1991. Order Number DE92000077. Source: OSTI; NTIS; GPO Dep.

Three sodium and mixed-alkali silicate glasses were studied to separate bulk relaxation processes from those due to electrode blocking. Conductance, G, and capacitance, C, were measured as a function of frequency over a wide range of temperature. Electrode effects were separated by their dependence on the type of electrode and sample thickness. We found no evidence for a bulk relaxation loss peak but the residual bulk process took the form of the well-known "universal" behavior involving power-law dependence of both G and C, with a fractional exponent, s, close to 0.6. The corresponding relaxation time has precisely the same activation energy as the dc conductivity. By extending the measurements to low temperatures, we find that s becomes equal to unity at the lower temperatures. 12 refs., 3 figs., 1 tab.

**34550** (DOE/ER/13612–7) **Infrared study of carbon deposits on bimetallic catalysts: Progress report, December 1, 1989–November 30, 1991.** Eischens, R.P. Lehigh Univ., Bethlehem, PA (United States). Zettlemoyer Center for Surface Studies. [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13612. Order Number DE91017726. Source: OSTI; NTIS; GPO Dep.

During this two-year period emphasis has been on a study of coke deposition on platinum-tin/alumina and an attempt to clarify the mechanism which produces oxidized species in the coke. The objective has been to relate the infrared studies of coke deposition to an understanding of the performance of bimetallic/alumina catalysts which are used in the commercial process of reforming which is used to produce high octane gasoline. Catalytic reforming is one of the most important catalytic processes in the petroleum industry. Since a dispersion of platinum might enhance coke deposition, a study of exposed platinum area was made using CO as the adsorbent. 6 refs., 5 figs.

**34551** (INIS-SU–266, pp. 101-102) **Radiolysis and radiation-induced crosslinking of binding polymers of working layer of magnetic ribbons under accelerated electron irradiation.** Bogolyubskij, A.V.; Boldyreva, T.V.; Prokopenko, T.V.; Ivanchenko,

R.I.; Machul'skij, B.M.; Mogil'nyj, A.F. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373--: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. POLYURETHANES/radiation curing; POLYURETHANES/radiolysis; ELECTRONS; FILMS; MAGNETIC TAPES; POLYURETHANES; RADIOLYSIS; TENSILE PROPERTIES

**34552** (INIS-SU--266, pp. 110) **Radiation protection of physical and mechanical properties of nitrocelluiose films.** Govorkov, A.T. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373--: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NITROCELLULOSE/radiation effects; NITROCELLULOSE/radiation protection; DOSE-RESPONSE RELATIONSHIPS; FILMS; GAMMA RADIATION; NITROCELLULOSE; RADIOPROTECTIVE SUBSTANCES; TENSILE PROPERTIES

**34553** (INIS-SU--266, pp. 118) **Deformability and strength properties of irradiated polyethylene with heterogeneous net of lateral bonds.** Gor'kov, D.A. (AN SSSR, Moscow (USSR). Inst. Khimicheskoj Fiziki); Karadzhev, A.K.; Nikol'skij, V.G.; Styrikovich, N.M.; Filippov, V.V.; Kechek'yan, A.S.; Finkel', Eh.Eh.; Gnezdilova, R.B. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373--: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. POLYETHYLENES/radiation curing; POLYETHYLENES/tensile properties; CHEMICAL BONDS; COBALT 60; DOSE-RESPONSE RELATIONSHIPS; FILMS; GAMMA RADIATION; POLYETHYLENES

**34554** (INIS-SU--266, pp. 152-153) **Unadditivity under combined irradiation of zinc oxide-polymethyl siloxane system by ultraviolet radiation, protons and electrons.** Mikhajlov, M.M. (Tomskij Politekhnicheskij Inst., Tomsk (USSR)); Dvoretskij, M.I.; Kuznetsov, N.Ya.; Nakhalov, S.B. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373--: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 4 figs. SILOXANES/optical properties; SILOXANES/radiation effects; ZINC OXIDES/optical properties; ZINC OXIDES/radiation effects; ELECTRONS; KEV RANGE 01-10; KEV RANGE 10-100; PROTONS; SILOXANES; TIME DEPENDENCE; ULTRAVIOLET RADIATION

**34555** (INIS-SU--266, pp. 154-155) **Peculiar features of optical degradation of $ZrO_2$+polymethylsiloxane system under separate and combined ultraviolet and electron irradiation.** Mikhajlov, M.M. (Tomskij Politekhnicheskij Inst., Tomsk (USSR)); Dvoretskij, M.I.; Kuznetsov, N.Ya. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373--: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. SILOXANES/optical properties; SILOXANES/radiation effects; ZIRCONIUM OXIDES/optical properties; ZIRCONIUM OXIDES/radiation effects; COATINGS; ELECTRONS; SILOXANES; ULTRAVIOLET RADIATION

**34556** (INIS-SU--266, pp. 161) **Thermography of climatically and radiation aged polymers.** Rashidov, D.; Misrov, S.; Tujchiev, Sh.; Bogdanov, A.I.; Dzhanobilov, K. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373--: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. POLYMERS/radiation effects; AGING; COBALT 60; GAMMA RADIATION; MELTING POINTS; PHASE TRANSFORMATIONS; POLYMERS; THERMOGRAPHY

**34557** (INIS-SU--266, pp. 175) **Radiation-induced modification of inorganic materials with organic silicon compounds.** Chirakadze, G.G.; Karkusashvili, T.G.; Tushurashvili, R.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373--: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. CERAMICS/phase transformations; CERAMICS/radiation effects; ORGANIC SILICON COMPOUNDS/phase transformations; ORGANIC SILICON COMPOUNDS/radiation effects; CERAMICS; CHEMICAL COMPOSITION; COBALT 60; DOSE RATES; GAMMA RADIATION; IMPREGNATION; RADIATION DOSES

**34558** (INIS-SU--266, pp. 177) **X-ray diffraction study of structure of irradiated amorphous red phosphorus.** Shechkov, G.T. (Altajskij Politekhnicheskij Inst., Barnaul (USSR)); Krutova, G.I.; Zimin, S.N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373--: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. PHOSPHORUS/radiation effects; DENSITY; ELECTRIC CONDUCTIVITY; ENERGY GAP; GAMMA RADIATION; MEDIUM TEMPERATURE; PHOSPHORUS; POLYMERIZATION

**34559** (INIS-SU--276, pp. 67) **The preparation technology of tungsten hexafluoride of pure reagent grade.** Borisenko, T.N.; Andreev, P.E.; Shajdurov, V.S. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215--: 9. all-union conference on chemistry

of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. TUNGSTEN FLUORIDES/purification; CHEMISORPTION; DISTILLATION; IMPURITIES; PURIFICATION

**34560** (INIS-SU–276, pp. 76) **Investigation of the slag reprocessing process of calcium thermal reduction smelting of rare earth and transition metal fluorides.** Bujnovskij, A.S.; Kobzar', Yu.F.; Kuptsova, D.I.; Mikhajlenko, G.A.; Portnyagina, Eh.A.; Sofronov, V.L.; Shtefan, Yu.P. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPOUNDS/reduction; RARE EARTH COMPOUNDS/waste processing; TRANSITION ELEMENT COMPOUNDS/reduction; TRANSITION ELEMENT COMPOUNDS/waste processing; CALCIUM; CHEMICAL REACTION YIELD; FLOWSHEETS; FLUORIDES; PYROMETALLURGY; REDUCTION; SLAGS; SMELTING

**34561** (INIS-SU–276, pp. 64) **Manufacture, optical and electrical properties of $CdF_2$-$AlF_3$-$CdGeO_3$ system glasses.** Bogdanov, V.L.; Mitrofanov, V.V.; Istomin, P.V.; Khalilev, V.D. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ALUMINIUM FLUORIDES/electric conductivity; ALUMINIUM FLUORIDES/synthesis; CADMIUM FLUORIDES/electric conductivity; CADMIUM FLUORIDES/synthesis; SYNTHESIS; CADMIUM OXIDES; GERMANIUM OXIDES; GLASS; OPTICAL PROPERTIES

**34562** (INIS-SU–276, pp. 102) **Borolanthanum glasses with strontium and yttrium fluorides.** Galant, V.E.; Nosyreva, E.B. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BORON OXIDES/glass; LANTHANUM OXIDES/glass; STRONTIUM FLUORIDES/glass; YTTRIUM FLUORIDES/glass; GLASS; CRYSTALLIZATION; FABRICATION

**34563** (IS-T–1504) **Structures and thermodynamics of some rare earth sulfides.** Zhang, Yan. Ames Lab., IA (United States). 5 Sep 1991. 117p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE91018554. Source: OSTI; NTIS; GPO Dep.

The vaporization behavior of the Nd-S and Yb-S systems was studied at 1952–2229K and 1688–1842K respectively. The congruent vaporizing compounds found in both systems are non-stoichiometric compounds, i.e., $NdS_{1.38}$ and $Yb_{0.877}S$. The equilibrium partial pressures of the gaseous species, the second- and third-law enthalpies and entropies of the vaporization reaction were obtained. Two new thulium sulfides: $Tm_8S_{11}$ and $Tm_{15}S_{22}$ were discovered by vaporization of Tm-S samples using the Knudsen effusion method. Single crystals of both compounds were obtained and their structures were solved by single crystal x-ray diffraction techniques. 103 refs., 11 figs., 19 tabs.

**34564** (JAERI-M–91-090) **Effect of thermal annealing on property changes of neutron-irradiated non-graphitized carbon materials and nuclear graphite.** Matsuo, Hideto (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 20p. Order Number DE92704180. Source: OSTI; NTIS (US Sales Only); INIS.

Changes in dimension of non-graphitized carbon materials and nuclear graphite, and the bulk density, electrical resistivity, Young's modulus and thermal expansivity of nuclear graphite were studied after neutron irradiation at 1128-1483 K and the successive thermal annealing up to 2573 K. Carbon materials showed larger and anisotropic dimensional shrinkage than that of nuclear graphite after the irradiation. The irradiation-induced dimensional shrinkage of carbon materials decreased during annealing at temperatures from 1773 to 2023 K, followed by a slight increase at higher temperatures. On the other hand, the irradiated nuclear graphite hardly showed the changes in length, density and thermal expansivity under the thermal annealing, but the electrical resistivity and Young's modulus showed a gradual decrease with annealing temperature. It has been clarified that there exists significant difference in the effect of thermal annealing on irradiation-induced dimensional shrinkage between graphitized nuclear graphite and non-graphitized carbon materials. (author).

**34565** (LA-UR–91-2862) **Optical properties of MX chain materials: An extended Peierls-Hubbard model.** Bishop, A.R.; Batistic, I.; Gammel, J.T.; Saxena, A. Los Alamos National Lab., NM (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9108168–1: Optical probes of conjugated polymers conference, Snowbird, UT (United States), 19-22 Aug 1991). Order Number DE92000314. Source: OSTI; NTIS; GPO Dep.

We describe theoretical modeling of both pure (MX) and mixed-halide ($MX_xX'_{1-x}$) halogen (X)-bridged transition metal (M) linear chain complexes in terms of an extended Peierls-Hubbard, tight-binding Hamiltonian with 3/4-filling of two-bands. Both inter- and intra-site electron-phonon coupling are included. Electronic (optical absorption), lattice dynamic (IR, Raman) and spin (ESR) signatures are obtained for the ground states, localized excited states produced by impurities, doping or photo-excitation – excitons, polarons, bipolarons, solitons; and the edge states (which occur in mixed-halide crystals, e.g. $PtCl_xBr_{1-x}$). Adiabatic molecular dynamics is used to explore photodecay channels in pure and impure systems for ground states as well as in the presence of pre-existing polaronic states. 12 refs., 3 figs., 1 tab.

**34566** (LA-UR–91-2975) **Interfacial fracture toughness of alumina/niobium systems.** Stout, M.G. (Los Alamos National Lab., NM (United States)); O'Dowd, N.P.; Shih, C.F. Los Alamos National Lab., NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Grant N00014-90-J1380. (CONF-911213–10: American Society of Mechanical Engineers (ASME) annual winter meeting, Atlanta, GA (United States), 1-6 Dec 1991). Order Number DE92000215. Source: OSTI; NTIS; GPO Dep.

The interfacial fracture toughness of an alumina/niobium composite has been measured as a function of phase angle. The interface was formed by solid-state bonding bulk Coor's AD-999 fine-grain alumina with a commercial purity niobium at 1600°C for 0.5 hr under a pressure of 10.5 MPa. The alumina/niobium system has a number of features which makes it ideal for an investigation of interfacial fracture toughness. From HREM data we estimate that the width of the interface is no more than 10 atomic planes. Furthermore the thermal expansion coefficients of the two materials differ by less than 5% so residual stresses due to the bonding process are small. Using symmetric and asymmetric four point bend specimens we have measured the fracture toughness of homogenous alumina and that of the alumina/niobium bimaterial in combinations of in-plane shear and tension. The fracture toughness of the homogenous alumina is relatively insensitive to the loading phase. The measured fracture toughness $K_c$ of the interface, however, depended strongly on phase angle. We were unable to obtain valid alumina/niobium interfacial toughness data at negative phase angles as the fracture initiates in the alumina and not at the interface. In symmetric bending at a phase angle $\approx 5°$,

we measured a nominal interface toughness of 4.0 $MPa\sqrt{m}$, comparable to the homogeneous alumina. We found that the toughness increased with loading phase angle to a value of $K_c \approx 9$ $MPa\sqrt{m}$ at a phase between 25° and 40°. Preliminary calculations and experiments suggest that this effect is due to an asymmetric stress distribution, with respect to the interface, and plastic deformation in the niobium. 12 refs., 9 figs., 1 tab.

**34567** (LBL–30112) **Microscopic determination of stress distribution in GaAs grown at low temperature on GaAs (100).** Liliental-Weber, Z. (Lawrence Berkeley Lab., CA (United States)); Tanaka, M.; Ishikawa, A.; Teriauchi, M. Lawrence Berkeley Lab., CA (United States). Jan 1991. 7p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). (CONF-901105–129: Fall meeting of the Materials Research Society (MRS), Boston, MA (United States), 24 Nov - 1 dec 1990). Order Number DE92000868. Source: OSTI; NTIS; GPO Dep.

A microscopic strain distribution across commensurate interfaces between GaAs layers grown on semi-insulating GaAs substrates was observed by means of convergent beam electron diffraction (CBED) and large angle convergent beam methods (LACBED). Strain relaxation at a specific distance from the interface was observed in these layers without formation of misfit dislocations. It was proposed that specific point defects distributed close to the interface can explain the asymmetric broadening of high-order Laue zone (HOLZ) lines in the CBED patterns. 17 ref., 3 figs.

**34568** (LBL–30148) **Vibrational Raman characterization of hard carbon and diamond films.** Ager, J.W. III (Lawrence Berkeley Lab., CA (United States)); Veirs, D.K.; Cho, Namhee; Rosenblatt, G.M.; Marchon, B. Lawrence Berkeley Lab., CA (United States). Jan 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-910123–35: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (United States), 20-25 Jan 1991). Order Number DE92000901. Source: OSTI; NTIS; GPO Dep.

Amorphous "hard carbon" and microcrystalline diamond films are being investigated and characterized using high-sensitivity and spatial-profiling Raman spectroscopy. The "hard carbon" films have broad Raman spectra with no diamond line while higher quality diamond films show only a single sharp diamond line. Features in the Raman spectra of the amorphous "hard carbon" films correlate with the rates of specific types of wear. Changes in the relative intensity of the Raman band near 1570 $cm^{-1}$ (G-band) compared to the band near 1360 $cm^{-1}$ (D-band) are related to the rate of abrasive wear. Shifts in the frequency of the G-band are related to the rate of tribochemical wear. The results are consistent with a structural model of amorphous carbon films in which small (<20Å) graphitic microcrystals comprised of $sp^2$ bonded domains are cross-linked by $sp^3$ carbon atoms. Profiles of Raman frequency and linewidth obtained from spatially resolved Raman spectroscopy across CVD-grown diamond thin films show that the Raman frequency and position are correlated in these films and that both change in regions of poorer film quality. 14 refs., 4 figs.

**34569** (ORNL/ATD–54) **Fiberglass material specification II.** Frame, B.J.; Janke, C.J. Oak Ridge National Lab., TN (United States). Applied Technology Div. Sep 1991. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000710. Source: OSTI; NTIS; GPO Dep.

This document describes the specifications for composite parts made of fiberglass materials for the Martin Marietta Energy Systems, Inc. (JL)

**34570** (SAND–91-0648C) **Microscopic origin of the light-induced defects in hydrogenated nitrogen-rich amorphous silicon nitride films.** Kanicki, J. (International Business Machines Corp., Yorktown Heights, NY (United States). Thomas J. Watson Research Center); Warren, W.L.; Seager, C.H.; Crowder, M.S.; Lenahan, P.M. Sandia National Labs., Albuquerque, NM (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9108122–2: 14. International Council of the Aeronautical Sciences (ICAS) conference, Garmisch-Partenkirchen (Germany), 19-23 Aug 1991). Order Number DE91019065. Source: OSTI; NTIS; GPO Dep.

We report on a possible microscopic origin of the UV light-induced silicon and nitrogen dangling bonds and positive charge in TFT gate-quality N-rich amorphous silicon nitride films deposited by PECVD at the substrate temperatures of 250 and 400°C. 12 refs., 3 figs.

**34571** (SAND–91-0653C) **The large deformation elastic response of woven Kevlar fabric.** Warren, W.E. Sandia National Labs., Albuquerque, NM (United States). [1991]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911213–1: American Society of Mechanical Engineers (ASME) annual winter meeting, Atlanta, GA (United States), 1-6 Dec 1991). Order Number DE91010582. Source: OSTI; NTIS; GPO Dep.

The large deformation elastic response of a plane woven Kevlar fabric is investigated analytically and experimentally. The analysis assumes the undeformed geometry to be a sequence of interlaced arcs of circles which reverse at each yarn midpoint, ad each yarn is modeled as an extensible elastical subject to certain compatibility conditions. Deflection-force relations for the fabric are determined in terms of the initial weave geometry and the elastic properties of the individual yarns. The theoretical results agree well with the results of experiments performed on a fabric woven from 400 denier Kevlar yarns under conditions of uniaxial loading in both warp and fill directions. 13 refs., 4 figs.

**34572** (SAND–91-0995C) **Strained quantum well InGaSb/AlGaSb heterostructures grown by molecular beam epitaxy.** Klem, J.F.; Lott, J.A.; Schirber, J.E.; Kurtz, S.R. Sandia National Labs., Albuquerque, NM (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109208–4: International symposium on gallium arsenide and related compounds, Seattle, WA (United States), 23-26 Sep 1991). Order Number DE92000997. Source: OSTI; NTIS; GPO Dep.

Strained, modulation-doped InGaSb/AlGaSb quantum wells were grown on InP substrates by molecular beam epitaxy and characterized by magneto-transport measurements. Hole transport properties were strongly correlated with growth conditions. Shubnikov-de Haas measurements yielded a hole mass of $(0.15\pm0.02)$ $m_o$, and hole mobilities as high as 3300 $cm_2/Vs$ were obtained at 77K, with a density of $1.6\times10_{12}$ $cm^{-2}$, thus showing promise for p-type field-effect transistor applications. 9 refs., 4 figs.

**34573** (SAND–91-1188C) **Piezoelectric polarization of the ferroelectric polymer PVDF from 10 MPa to 10 GPa: Studies of loading-path dependence.** Graham, R.A. (Sandia National Labs., Albuquerque, NM (United States)); Anderson, M.U.; Setchell, R.E.; Bauer, F. Sandia National Labs., Albuquerque, NM (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9107105–51: 1991 American Physical Society (APS) conference on shock compression of condensed matter, Williamsburg, VA (United States), 17-20 Jul 1991). Order Number DE91018813. Source: OSTI; NTIS; GPO Dep.

Short communication. POLYVINYLS/impact shock; POLYVINYLS; PIEZOELECTRICITY; THIN FILMS; FERROELECTRIC MATERIALS; STRESSES; PRESSURE EFFECTS; FLUORINATED ALIPHATIC HYDROCARBONS; REMOTE SENSING

**34574** (SAND–91-1551C) **Molecular to material design for anomalous-dispersion phase-matched second harmonic generation.** Cahill, P.A. (Sandia National Labs., Albuquerque, NM (United States)); Tallant, D.R.; Kowalcyzk, T.C.; Singer, K.D. Sandia National Labs., Albuquerque, NM (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9107115–43: Society of Photo-Optical Instrumentation Engineers (SPIE) meeting, San Diego, CA (United States), 21-26 Jul 1991). Order Number DE91017999. Source: OSTI; NTIS; GPO Dep.

Anomalous-dispersion phase-matching (ADPM) offers large enhancements in the effective hyperpolarizabilities of nonlinear optical processes such as second harmonic generation (SHG) in organic

materials. The principal barrier to the practical application of this approach is the residual absorption of asymmetric organic chromophores at the second harmonic which is shown by calculation to inherently limit the efficiency of SHG. Resonance Raman experiments on a nonlinear optical (NLO) dye optimized for doubling 800 nm light indicate that the residual absorbance is probably due to vibronic levels associated with the electronic absorption. Recent work with the films of PMMA doped with this ADPM dye showed zero dispersion at approximately 6% concentration. 5 refs., 8 figs.

**34575** (SAND–91-1847C) **Diffraction by macromolecular fluids.** Narten, A.H. (Oak Ridge National Lab., TN (United States)); Habenschuss, A.; Honnell, K.G.; McCoy, J.D.; Curro, J.G.; Schweizer, K.S. Oak Ridge National Lab., TN (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400 ;AC04-76DP00789. (CONF-911209–1: Faraday symposium no. 27: the conformations of flexible molecules in fluid phases, Southampton (United Kingdom), 16-18 Dec 1991). Order Number DE91016219. Source: OSTI; NTIS; GPO Dep.

X-ray diffraction data on n-alkane fluids ranging from n-butane to polyethylene are analyzed to yield the relative contributions from intra- and intermolecular scattering. The intramolecular contributions are calculated from an exact rotational-isomeric-state model at short length scales, and approximately by a self-consistent semi-flexible chain model at global scales. With increasing chain length, the intermolecular pair distribution functions show the predicted self-screening, or de Gennes "correlation hole," whereby sites on different chains are partially excluded from close approach to sites on a given chain. 23 refs., 4 figs.

**34576** (SAND–91-1883C) **Photothermal deflection spectroscopy of conjugated polymers.** Seager, C.H. (Sandia National Labs., Albuquerque, NM (United States)); Sinclair, M.; McBranch, D.; Heeger, A.J.; Baker, G.L. Sandia National Labs., Albuquerque, NM (United States). [1991]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9108156–1: American Chemical Society (ACS) meeting, Salt Lake City, UT (United States), 19-22 Aug 1991). Order Number DE91018318. Source: OSTI; NTIS; GPO Dep.

Along with the third order, non-linear susceptibility, $X^{(3)}$, the magnitude of the optical absorption in the transparent window below the principal absorption edge is an important parameter for conjugated polymers used in active integrated optical devices. Photothermal Deflection Spectroscopy (PDS) is an ideal technique for determining the absorption coefficients of thin films of "transparent" materials. We have used PDS to measure the optical absorption spectra of the conjugated polymers poly [1,4-phenylene- vinylene] (and derivatives) and polydiacetylene-4BCMU in the spectral region from 0.55 eV to 3 eV. We find that the shape of the absorption edge varies considerably from polymer to polymer, with polydiacetylene-4BCMU having the steepest absorption edge. The minimum absorption coefficients measured varied somewhat with sample age and quality, but were typically in the range 1 $cm^{-1}$ to 10 $cm^{-1}$. In the region below 1 eV, overtones of C-H stretching modes dominate the absorption behavior. We also observe that irradiation of all of these polymers with light above ~2.5 eV produces enhanced absorption below the fundamental edge. In the absence of light, these excitations decay with characteristic times of 10–1000 sec., and in some cases they may determine the effective IR transparency in the 1.0–1.8 eV energy range. 14 refs., 6 figs.

**34577** (SAND–91-1992C) **Shock characterization of nitrocellulose-based gun propellant.** Weirick, L.J. Sandia National Labs., Albuquerque, NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911198–1: 5. international gun propellant and propulsion symposium, Dover, NJ (United States), 19-21 Nov 1991). Order Number DE91019057. Source: OSTI; NTIS; GPO Dep.

A series of shock-loading experiments on a nitrocellulose-based (NC-based) gun propellant was conducted using a light-gas gun. The intent of this work was to characterize the shock sensitivity of the gun propellant. The initial objectives were to obtained Hugoniot data and to investigate the pressure threshold at which a reaction initiates. For the Hugoniot/reaction threshold experiments, 1/4-length grains of propellant were mounted on the front of projectiles and were impacted onto either polymethylmethacrylate (PMMA), fused silica or sapphire targets at velocities as high as 1.4 mm/$\mu$s, the upper limit of the gun. The particle velocity data obtained from the VISAR (Velocity Interferometer System for Any Reflector) records for the propellant fit a Hugoniot curve found in the Russian literature for a double-base, NC-nitroglycerine propellant. The density initial bulk sound velocity, and empirical parameter S values for the gun propellant were 1.63 g/$cm^3$, 1.70 mm/$\mu$s and 1.85, respectively. VISAR data were also used to obtained the ignition threshold pressures of the gun propellant. Reactions were observed at impact pressures of 2.6 GPa and above. 5 refs., 6 figs., 1 tab.

**34578** (SAND–91-2014C) **Solid state radioluminescent sources using tritium-loaded zeolites.** Gill, J.T. (EG and G Mound Applied Technologies, Miamisburg, OH (United States)); Hawkins, D.B.; Renschler, C.L. Sandia National Labs., Albuquerque, NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789 ;AC04-88DP43495. (CONF-910920–3: 4. topical meeting on tritium technology in fission, fusion, and isotopic applications, Albuquerque, NM (United States), 30 Sep - 4 oct 1991). Order Number DE91019061. Source: OSTI; NTIS; INIS; GPO Dep.

Zeolite-based tritium lamps are a possible alternative to traditional tritium gas tube light sources. Rare earth luminescing centers may be ion-exchanged into zeolite matrices. Close proximity of tritium atoms to the rare earths can be provided by highly tritiated water sorbed within the pore structure of the zeolite aluminosilicate matrix. Zeolites are optically clear and radiation stable. Light outputs from tritium-loaded zeolites are shown here to exceed 2$\mu$W/$cm^2$, with good stability. Procedures for obtaining light sources are presented and results are discussed. The possible use of these luminescent materials as process monitors for zeolite absorption columns in tritium service is also discussed. 13 refs., 3 figs.

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**34579** (INIS-SU–253/A) **17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.** AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

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*Refer also to citation(s) 33562, 33576, 33591, 33598, 33729, 33776, 34041, 34042, 34044, 34408, 34576, 34713, 34962, 34975, 34991, 35150*

**34580** (AECS-C/FRSR–42) **Study of the interference of uranium, vanadium, aluminium and molebdenum in the determination of FeII, FeIII in Syrian phosphoric acid by spectrophotometry.** Zaizafoun, Ghadir (Atomic Energy Commission, Damascus (Syria)); Elian, Nazha. Atomic Energy Commission, Damascus (Syrian Arab Republic). Apr 1991. 8p. (In Arabic). Order Number DE91643928. Source: OSTI; NTIS (US Sales Only).

The spectrophotometric determination of the ratio of $iron_I$I to $iron_{II}$ in crude phosphoric acid is of great importance because of its influence on the redox potential in the different stages which lead to the extraction of uranium from crude phosphoric acid. The suitability of a number of reagents for this determination was examined and only 1,10-phenanthroline, 5-sulfosalicylic acid and 2,2'-bipyridine were selected for further experimentation. 1-10-phenanthroline can give a deep red complex with $Fe_I$I, in phosphoric acid medium at PH 4-6, absorbs at $\lambda$ = 510 nm. The

total iron was determined by reducing $Fe_{II}$II to $Fe_{II}$I using hydroxylamine hydrochloride. The second reagent was found capable of forming a yellow complex absorbs light at $\lambda$ = 430 nm in amonia medium at PH 8.5 - 11 with $Fe_{II}$II. The adopted procedure was to determine total iron first by oxidation with nitric acid. Then $iron_{II}$ was determined in a second test at PH 1.5 and at $\lambda$ = 500 nm. The third reagent i.e. 2-2' bipyridine is capable of forming a red complex with $iron_{II}$ absorbs at $\lambda$ = 522 nm. The interference of U, V, Al, and Mo was investigated. These elements were selected because of their presence in considerable amounts in Syrian commercial phosphoric acid. The work was designed so that the effect of the presence of each element as well as the presence of all possible combinations of these elements can be estimated. The investigation revealed that the interference is very high in the case of 2-2' bipyridine in addition to the instability of the complex. In the case of 1,10-phenanthroline the interference was also found high. Thus these two reagents were disregarded. The 5-sulfosalicylic reagent was found satisfactory when determining $iron_{II}$II. However when $Fe_{II}$ is considered the error resulting from interference ranges between 17.5 - 50%. (Abstract Truncated)

**34581** (ANL/CP–73631) **Combining extractant systems for the simultaneous extraction of transuranic elements and selected fission products.** Horwitz, E.P. Argonne National Lab., IL (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9107153–2: Hanford separations workshop, Richland, WA (United States), 23-25 Jul 1991). Order Number DE91018546. Source: OSTI; NTIS; GPO Dep.

A stand alone acid-side SX process for removal of uranium and transuranic elements (Np, Pu, Am) from nuclear waste (TRUEX) has been widely reported in the last five years. Recently, an acid-side SX process to extract and recover $^{90}Sr$ from high-level nuclear waste (SREX) has also been reported. Both the TRUEX and SREX processes extract $T_c$to a significant extent although not as efficiently as TRUs and Sr. Ideally, one would like to have a process that can extract and recover all actinides, as well as $^{99}Tc$, $^{90}Sr$ and $^{137}Cs$. Such a process would remove the most toxic long-lived isotopes as well as the long-lived fission product that readily migrates and the major heat producing isotopes. The basic problem in designing an SX system to remove such a wide range of elements is that no single ligand is capable of coordinating selectively to elements with such widely differing chemical properties. Possible solution to multielement extraction is to mix two extractants with totally different properties into a single process solvent formulation. 2 figs., 3 tabs., 4 refs.

**34582** (CIEMAT–660) **Spectrographic determination of impurities in ceramic materials for nuclear fusion reactors. 1. Analysis of alumina.** Rucandio, I.; Roca, M.; Melon, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1990. 20p. (In Spanish). Order Number DE92700004. Source: OSTI; NTIS (US Sales Only).

The determination of minor and trace elements in the aluminium oxide considered as possible ceramic material in thermonuclear fusion reactors has been studied. The concentration ranges are 0.1-0.3 % for Ca, Si and Y, and at the ppm level for Co, Cr, Fe, Hf, K, Li, Mg, Mn, Na, Ni, Sc, Ta, Ti, V and Zr. Atomic emission spectroscopy with direct current arc excitation and photographic detection has been employed. For Hf, Mg, Ta, Ti, V and Zr the use of 40% of copper fluoride as a carrier and of Nb as internal standard provide suitable sensitivities and precisions, while for the rest of elements the best results are obtained with graphite powder in different proportions and Rb or Sn as internal standard. (Author)

**34583** (CIEMAT–663) **Spectrographic determination of impurities in ceramic materials for nuclear fusion reactors. Pte2. Analysis of magnesium aluminate.** Roca, M.; Rucandio, M.I.; Melon, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1990. 19p. (In Spanish). Order Number DE92700005. Source: OSTI; NTIS (US Sales Only).

The determination of minor and trace elements in the magnesium aluminate, considered as possible material in thermonuclear fusion reactors, has been studied. The concentration ranges are 0.1-0.3 % for Ca, Si and Y, and at the ppm level for Co, Cr, Fe, Hf, K, Li, Mn, Na, Ni, Sc, Ta, Ti, V and Zr. Atomic emission spectroscopy with direct current arc excitation and photographic detection has been employed. For Hf, Ta and Zr the use of 40% of copper fluoride as a carrier and of Nb as internal standard provide suitable sensitivities and precisions, while for the rest of elements the best results are obtained with graphite powder in different proportions and Rb or Sn as internal standard. (Author)

**34584** (CIEMAT–664) **Simultaneous determination of RA-226, natural uranium and natural thorium by gamma-ray spectrometry INa(Tl) in solid samples.** Salvador, S.; Navarro, T.; Alvarez, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1990. 23p. (In Spanish). Order Number DE92700006. Source: OSTI; NTIS (US Sales Only).

A method has been described to determine activities of Ra-226, natural uranium, and natural thorium, by gamma-ray spectrometry. The system was calibrated for efficiency by using synthetic calibrated standards. It is necessary, in the samples, to assume secular equilibrium between Ra-226 and Th-232 and its daughters nuclides, and U-238 and its immediate daughter Th-234, because the photopeaks measured are from these daugthers. Our results indicate that a nondestructive gamma spectrometric method can often replace the radiochemical techniques used in measuring radioactivities in this type of samples. (Author)

**34585** (CONF-9107178–1) **Laser ablation mass spectrometry of levitated microparticles.** Dale, J.M.; Whitten, W.B.; Ramsey, J.M. Oak Ridge National Lab., TN (United States). [1991]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Chemical Research and Development Engineering Center (CRDEC) conference on obscuration and aerosol research; Aberdeen, MD (United States); 23-26 Jul 1991. Order Number DE92000451. Source: OSTI; NTIS; GPO Dep.

Short communication. CHARGED PARTICLES/laser spectroscopy; CHARGED PARTICLES/levitation; MASS SPECTROSCOPY; ABLATION; DESORPTION; LEVITATION; SILICON CARBIDES; AMMONIUM HALIDES; NIOBIUM

**34586** (DOE/ER/13002–1) **Reactor analysis for selective metal ion extraction in liquid dispersions: Final report, June 1, 1985–August 31, 1987.** Tavlarides, L.L. Syracuse Univ., NY (United States). Dept. of Chemical Engineering and Materials Science. Feb 1988. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-82ER13002. Order Number DE91018202. Source: OSTI; NTIS; GPO Dep.

The goal of this project is to provide fundamental models for the rational design of liquid extraction processes to predict conversion and selectivity for the hydrometallurgical extraction of metals. The dispersed phase models developed incorporate thermodynamic chemical equilibria, chemical kinetics, mass transfer processes, and droplet mixing. Thermodynamic phase equilibrium and kinetic data for two systems have been obtained and analyzed for models to predict interfacial flux. The interfacial kinetics of the iron (3) sulfate-$\beta$-alkenyl-8-hydroxy quinoline ($\beta$A8HQ)/xylene system were studied using a liquid jet recycle reactor. Also, a kinetic model in the presence of mass transfer was developed for the cobalt(2) nitrate-acetate buffer/di-(2-ethylhexyl) phosphoric acid-toluene system in a modified Lewis cell contractor. The performance of a continuous flow stirred tank extractor (CFSTE) for the above two hydrometallurgical extraction systems was studied to verify predictive models. A novel laser capillary spectrophotometer was developed to measure bivariate drop size/concentration distributions in turbulent liquid dispersions. The instrument permits the analysis of the extent of droplet mixing on extractor performance. A dispersed phase simulation model was employed to analyze experiments for the cobalt extraction in a CFSTE. Excellent agreement was obtained between experiments and predictions. These results verify the utility of this fundamental approach.

**34587** (DOE/ER/13435–6) **Fundamental studies with a monodisperse aerosol-based liquid chromatography/mass spectrometry interface (MAGIC-LC/MS): Progress report, December 1, 1990–November 30, 1991.** Browner, R.F. Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemistry and Biochemistry. Sep 1991. 5p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract FG05-85ER13435. Order Number DE91018526. Source: OSTI; NTIS; GPO Dep.

We have carried out an extensive study of the particle beam interface from several methods of aerosol generator. First, we have studied the characteristics of the aerosol as a function of the operating parameters of the nebulizer. Second, we have attempted to correlate the aerosol characteristics with the quality of the mass spectra resulting from several different classes of compounds, covering a wide range of volatility and thermal lability. 6 refs., 7 figs.

**34588** (DOE/ER/13833–11) **Enhancement of fluorescence detection in chromatographic methods by computer analysis of second order data: Progress report, February 1, 1991–August 30, 1991.** Rutan, S.C. Virginia Commonwealth Univ., Richmond, VA (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13833. Order Number DE91018528. Source: OSTI; NTIS; GPO Dep.

Multiwavelength detectors offer improved detection capabilities for liquid chromatographic methods, but require improvements in data analysis methodology to utilize all the available information. In this work, various methods for improving the quantitative results obtained from liquid chromatography with full spectrum fluorescence detection are being studied. The availability of multiwavelength information allows overlapped chromatographic peaks to be resolved. We are also interested in using kinetic information to aid in the resolution of overlapped responses, however, in this case, the separations are accomplished using planar separation methods, rather than column chromatographic techniques. The principles of the proposed new analytical technique to perform the desired separation using thin-layer chromatography or gel electrophoresis. 3 refs.

**34589** (ETDE-IT–91-55) **Gaseous phase molecular spectroscopy with infrared-tunable diode lasers.** Baldacchini, G.; D'Amato, F.; Righi, F.; Cappellani, F.; Restelli, G. ENEA, Casaccia (Italy). Area Energia e Innovazione; Istituto Nazionale di Fisica Nucleare, Frascati (Italy). 1991. 32p. (In Italian). Order Number DE92705865. Source: OSTI; NTIS (US Sales Only).

After brief explanations of the physics aspects of qualitative and quantitative chemical analysis by gaseous phase molecular spectroscopy using infrared-tunable, diode lasers, this paper reports on the reliability and flexibility of this type of instrumentation as witnessed by its growing number of applications in various fields, e.g., environmental monitoring of atmospheric pollutants; industrial process, real time response of a gaseous component present in trace amounts; and medical diagnostics.

**34590** (EUR–13379) **Interlaboratory comparison exercise for the determination of uranium by potentiometric titration (first phase).** Verdingh, V. (Commission of the European Communities Geel (BE). Central Bureau for Nuclear Measurements); Le Duigou, Y.; Ketema, D.J.; Harry, R.J.S. Commission of the European Communities, Luxembourg (Luxembourg). 1991. 45p. Source: OSTI; NTIS (US Sales Only).

Upon request of the Esarda working group on low-enriched uranium conversion and fuel fabrication plants an interlaboratory comparison was organized, to assess the precision and accuracy concerning the determination of uranium by the potentiometric titration method. This report presents the results of the first phase of this exercise (pure uranyl-nitrate solutions). The solutions used in this intercomparison have been certified for their uranium content by the CBNM, Geel. Comparison of the laboratory results with the certified values shows excellent, good and fairly good agreement for many of the participating laboratories. 10 tabs., 5 figs., 10 refs.

**34591** (INIS-SU–276, pp. 43) **Use of xenon difluoride for oxygen extraction and determination in superconducting ceramics $YBa_2Cu_3O_{7-x}$.** Artyukhov, A.A.; Grigor'ev, G.Yu.; Nikitin, M.M. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. HIGH-TC SUPERCONDUCTORS/quantitative chemical analysis; OXYGEN/quantitative chemical analysis; XENON FLUORIDES/reagents; YTTRIUM OXIDES/high-tc superconductors; ACCURACY; BARIUM OXIDES; CERAMICS; COPPER OXIDES; GAS CHROMATOGRAPHY; ISOTOPE RATIO; MASS SPECTROSCOPY; OXYGEN; OXYGEN ISOTOPES; REAGENTS

**34592** (IS-T–1572) **Chemically modified polymeric resins for high performance liquid chromatography, solid-phase extraction and organic separation by LC and GC.** Sun, Jeffrey Jiafang. Ames Lab., IA (United States). 6 Aug 1991. 204p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE91018166. Source: OSTI; NTIS; GPO Dep.

Polystyrene divinylbenzene resins were chemically modified by introduction of various functional groups, which included polar, non-polar, ionic and metallic groups. These chemically modified polymeric resins were used successfully for high performance liquid chromatography, solid phase extraction and some special applications in liquid and gas chromatography. The introduced functional groups offer an additional selectivity parameter for liquid chromatographic separation. The polar derivatized polymeric resins dramatically increased the recoveries of solid phase extraction, especially for polar compounds. The sulfonated polystyrene resins were used for separation of neutral and basic compounds as well as basic and weaker basic compounds. The sulfonated non-porous resin was used amine abstracter and the polymeric-mercuric resin was used as mercaptan abstracter in capillary gas chromatograph. The researches in this dissertation has shown the very promising applications of polystyrene divinylbenzene resin in chromatographic field. 58 refs., 34 figs., 28 tabs.

**34593** (Juel–2452) **Preparation and analysis of analog material for comet simulation experiments KOSI. Contributions of Institut fuer Chemie 1 (Nuklearchemie), Forschungszentrum Juelich for Schwerpunktprogramm 'Kleine Koerper im Sonnensystem' of Deutsche Forschungsgemeinschaft DFG for the period 1 July 1987 to 17 February 1989.** Roessler, K. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Chemie 1 - Nuklearchemie; Deutsche Forschungsgemeinschaft, Bonn (Germany). Feb 1991. 70p. (In German). Contract DFG Ro 724/1-1. Order Number DE92714421. Source: OSTI; NTIS (US Sales Only); INIS.

The report describes the preparation of analog material for comet simulation experiments KOSI-1 to 3 in the big Space Simulator Chamber of DLR Koeln. Suspensions of minerals (mostly olivine, montmorillonite and kaolinite) are sprayed with $N_2$ or $CO_2$ gas into $LN_2$. The frozen $CO_2$ forms the volatile component responsible for dust and gas ejection. Other methods of ice sample preparation, including that of amorphous ice are presented. Analysis of the samples was performed mainly by optical spectrometry and gas chromatography of the volatile components. Laboratory experiments on binary and ternary ice mixtures are reported. The cryohandling and -analysis of the standard and the insolated samples was achieved in cold glove boxes with $LN_2$ baths. Material strength was measured by drilling boreholes with rods connected to a newtonmeter. The large mineral-ice sample of ca. 10 ltr. volume in the big Space Simulator Chamber are a first effort in comet simulation studies to scale up experiments which were until recently performed in small cryostats only, to better match the conditions of real comets. (orig.).

**34594** (KFK–4590) **The hybrid K-edge/K-XRF densitometer: Principles - design - performance.** Ottmar, H.; Eberle, H. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Kernphysik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Wiederaufarbeitung und Abfallbehandlung. Feb 1991. 76p. (PWA–01/91). Order Number DE92714303. Source: OSTI; NTIS (US Sales Only); INIS.

The Euratom Safeguards Directorate (ESD) has recently installed a hybrid K-edge/K-XRF densitometer in a commerical reprocessing plant for the safeguarding of nuclear materials. This instrument, developed at KfK Karlsruhe, offers for the first time analytical measurement capabilities for timely on-site input accountancy verification. Lectures providing informations on measurement principles, instrument design features and performance data have

been given to inspectors of ESD to make them familiar with the new instrument. This report summarizes the essential materials presented during these courses. (orig.).

**34595** (KFK–4872) **Chemical and X-ray diffraction analysis on selected samples from the TMI-2 reactor core.** Kleykamp, H.; Pejsa, R. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe GmbH (Germany). Hauptabteilung Versuchstechnik; Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. May 1991. 105p. Order Number DE92714348. Source: OSTI; NTIS (US Sales Only); INIS.

Selected samples from different positions of the damaged TMI-2 reactor core were investigated by X-ray microanalysis and X-ray diffraction. The measurements yield the following resolidified phases after cooling: Cd and In depleted Ag absorber material, intermetallic Zr-steel compounds, fully oxidized Zircaloy, $UO_2$-$ZrO_2$ solid solutions and their decomposed phases, and Fe-Al-Cr-Zr spinels. The composition of the phases and their lattice parameters as well as the eutectic and monotectic character can serve as indicators of local temperatures of the core. The reaction sequences are estimated from the heterogeneous equilibria of these phases. The main conclusions are: (1) Liquefaction onset is locally possible by Inconel-Zircaloy and steel-Zircaloy reactions of spacers and absorber guide tubes at 930deg C. However, increased rates of dissolution occur above 1200deg C. (2) $UO_2$ dissolution in the Inconel-steel-Zircaloy melt starts at 1300deg C with increased rates above 1900deg C. (3) Fuel temperatures in the core centre are increased above 2550deg C, liquid $(U,Zr)O_2$ is generated. (4) Square $UO_2$ particles are reprecipitated from the Incoloy-steel-Zircaloy-$UO_2$ melt during cooling, the remaining metallic melt is oxygen poor; two types of intermetallic phases are formed. (5) Oxidized Fe and Zr and $Al_2O_3$ from burnable absorber react to spinels which form a low melting eutectic with the fuel at 1500deg C. The spinel acts as lubricant for fuel transport to the lower reactor plenum above 1500deg C. (6) Ruthenium (Ru-106) is dissolved in the steel phase, antimony (Sb-125) in the $\alpha$-Ag absorber during liquefaction. (7) Oxidation of the Zircaloy-steel phases takes place mainly in the reflood stage 3 of the accident scenario. (orig.).

**34596** (ORNL/CSD/TM–282) **Simulation study of the sensitivity of isotope dilution analysis by mass spectrometry.** Bayne, C.K. Oak Ridge National Lab., TN (United States). Jul 1991. 63p. Sponsored by US Program for Technical Assistance (United States). DOE Contract AC05-84OR21400. (ISPO–333). Order Number DE91018610. Source: OSTI; NTIS; GPO Dep.

Isotope dilution analysis by mass spectrometry (IDMS) is a method of measuring elemental assays or concentrations. It is especially useful when only small samples are available for the element of interest. Safeguards Analytical Laboratory (SAL) of the International Atomic Energy Agency (IAEA) at Seibersdorf, Austria, applies IDMS to measure elemental assays in uranium samples (0.5–10 mg) and in plutonium samples (0.001-5 mg). SAL makes IDMS analyses on spent fuels or nuclear products when titration methods are impractical. Chemists quantitatively mix a known amount of sample with a measured isotopic composition with a known amount of tracer of the same element as the sample. The tracer is a material with a well-known elemental concentration. Tracer material is fabricated with one or more spike isotopes whose isotopic ratios are well characterized. These tracer isotopic spikes are usually in smaller abundances (e.g., $^{233}U$, $^{236}U$, $^{242}Pu$ and $^{244}Pu$) in the sample. Chemists make mass spectrometric measurements on the resulting isotopic composition of sample and tracer mixture. The elemental assay in the sample is then calculated. These calculations compare the spike isotopic ratio in the mixture with the spike isotopic ratio in the sample using the known quantity of spike in the tracer. 19 figs., 19 tabs., 14 refs.

**34597** (PNL-SA–19812) **Backscatter/fundamental-parameters analysis of unweighed samples using multi-target, multi-crystal, regions of interest from WDXRF and EDXRF.** Arthur, R.J.; Sanders, R.W. Pacific Northwest Lab., Richland, WA (United States). Aug 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-910862–4: Pacific-international congress on x-ray analytical methods, Honolulu, HI (United States), 12-16 Aug 1991). Order Number DE91018473. Source: OSTI; NTIS; GPO Dep.

A method has been developed to simultaneously compute matrix corrections from a composite spectrum of multi-target energy-dispersive (EDXRF) and multi-crystal wavelength-dispersive (WDXRF) x-ray fluorescence systems. A serial line installed between the WDXRF and EDXRF spectrometers via a PDP 11/34a computer allows acquired wavelength data to be digitally transformed into an energy spectrum. The low-energy x-ray information from the WDXRF unit is then coupled with the backscatter coherent/incoherent information from the EDXRF unit, enabling enhanced quantitative analysis for low-atomic-number (low-Z) elements. The peak resolution obtainable from the WDXRF spectra often removes the necessity for peak-overlap corrections. 8 refs., 3 tabs.

**34598** (PNL-TR–485) **Laser spectroscopy as an analytical technique for process control in waste management: Final report.** Herrmann, G. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie); Trautmann, N.; Rimke, H.; Mang, M.; Muehleck, C.; Riegel, J.; Sattelberger, P.; Ames, F.; Otten, E.W.; Rehklau, D.; Ruster, W.; Scheerer, F. Pacific Northwest Lab., Richland, WA (United States); Mainz Univ. (Germany). Inst. fuer Kernchemie. [1991]. 13p. Translation of INIS-mf–12100, June 1989. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91017839. Source: OSTI; NTIS; INIS; GPO Dep.

The application of laser resonance ionization mass spectroscopy for determining the [total] amount and isotopic composition of fissionable uranium and plutonium was explored. For this, various excitation schemes for the three-photon ionization had to be studied, and the excitation and ionization cross-sections for U-235, U-238, and Pu-239 [had to be] determined by using broadband and narrowband laser light. It can be shown that, using laser spectroscopic methods for uranium and plutonium, as few as $10^7$ atoms can be detected. For determination of isotopic composition, it is necessary to measure the hyperfine splitting of the odd [mass number] isotopes and the isotopic shifts. Isotopic analyses in the mass region 239–244 were carried out with plutonium samples within 10 to 20 min; these data compare well with mass spectrometric results. The elemental selectivity of this method is very high, as could be demonstrated in the case of uranium impurities [in plutonium samples]. Laser resonance ionization mass spectroscopy is suitable for fast determination of uranium and plutonium as well as for isotopic analysis, and can be instituted as an analysis technique for process control in waste management. 7 refs., 9 figs., 5 tabs.

**34599** (UJV–9203-B,V) **Manual of selected physico-chemical analytical methods. IV.** Beran, M.; Klosova, E.; Krtil, J.; Sus, F.; Kuvik, V.; Vrbova, L.; Hamplova, M.; Lengyel, J.; Kelnar, L.; Zakouril, K. Ustav Jaderneho Vyzkumu CSKAE, Rez (Czechoslovakia). Nov 1990. 48p. (In Czech). Order Number DE92600698. Source: OSTI; NTIS (US Sales Only); INIS.

For Part III see UJV–9204 CH (Dec 1990).

The Central Testing Laboratory of the Nuclear Research Institute at Rez has for a decade been participating in the development of analytical procedures and has been providing analyses of samples of different types and origin. The analytical procedures developed have been published in special journals and a number of them in the Manuals of analytical methods, in three parts. The 4th part of the Manual contains selected physico-chemical methods developed or modified by the Laboratory in the years 1986-1990 within the project "Development of physico-chemical analytical methods". In most cases, techniques are involved for non-nuclear applications. Some can find wider applications, especially in analyses of environmental samples. Others have been developed for specific cases of sample analyses or require special instrumentation (mass spectrometer), which partly restricts their applicability by other institutions. (author).

**34600** (Y/TR–91/21) **Removal of metal ions from aqueous solution by electrodialysis.** Miyagi, Yoshiyuki (Tosoh Corp., Yamaguchi (Japan)); Tabatake, Tomokazu; Kataoka, Tosha; Sato, Kimiyasu. Oak Ridge Y-12 Plant, TN (United States). [1991]. 13p. Translation of Japanese Patent Application 1989-80408, filed date September 24, 1987, publication date March 27, 1989. Sponsored

by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91018439. Source: OSTI; NTIS; GPO Dep.

A method is described for removing metal ions by electrodialysis characterized by dosing an aqueous solution containing metal ions with a chelating agent, letting chelated compounds of specific metal ions form in said aqueous solution, then removing the ions that cannot be accommodated by the chelate formation from said aqueous solution. Metal ions are removed by electrodialysis as specified (1) in which specific metal ions that form chelate are multi-valued, above valence; and (2) those ions not accommodated by the chelate formation are metal ions of valence 1. Metal ions are removed by electrodialysis as specified in which specific metal ions that form chelate are above valence 1, and those ions not accommodated by the chelate formation are metal ions of valence 1 or multi-valued. Metal ions are removed by electrodialysis as specified in which specific metal ions that form chelate and those that cannot be accommodated by the chelate are both multi-valued ions. 1 fig.

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*Refer also to citation(s) 33557, 33565, 33566, 33571, 33581, 33597, 33656, 33674, 33712, 33718, 33766, 33916, 34445, 34493, 34548, 34550, 34563, 34765, 34772, 34773, 34835, 35147, 35170, 35355*

**34601** (AECL–9923, pp. 7-18) **Kinetics of iodine hydrolysis in unbuffered solutions.** Palmer, D.A. (Oak Ridge National Lab., TN (USA)); Lyons, L.J. Organization for Economic Co-Operation and Development (OECD), 75 - Paris (France); Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment; Ontario Hydro, Toronto, ON (Canada). Mar 1989. (CONF-8806137–: 2. Committee on the safety of nuclear installations (CSNI) workshop on iodine chemistry in reactor safety, Toronto (Canada), 2-3 Jun 1988; CSNI–149.). In *Proceedings of the second CSNI workshop on iodine chemistry in reactor safety*. 331p. Order Number DE91642219. Source: OSTI; NTIS (US Sales Only); INIS.

The kinetics of hydrolysis or disproportionation of hypoiodite were studied spectrophotometrically in basic solution at an ionic strength of 0.2 M as a function of pH, iodide and total iodine concentration, and temperature. The existence of three independent pathways for this second-order process was confirmed. The pH-stat method was used to monitor the corresponding reaction of hypoiodous acid in weakly alkaline solution. The values of $k_a$ and $k_b$ are substantially smaller than previously reported. However, an unexplained contribution to the rate law resulting from the pH-stat measurements was also obtained. The rapid recombination of iodide and iodate in $HC1O_4$ solutions was followed by stopped-flow spectrophotometry at three ionic strengths, and over a range of iodide and hydrogen ion concentrations, and at eight temperatures. Fifth-order kinetics were observed with no detectable induction period.

**34602** (CONF-9108114–2) **Mixing effects in aqueous solutions at elevated temperatures.** Holmes, H.F.; Mesmer, R.E. Oak Ridge National Lab., TN (United States). [1991]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. international symposium on chemistry in high temperature water; Provo, UT (United States); 19-22 Aug 1991. Order Number DE91017695. Source: OSTI; NTIS; GPO Dep.

With few exceptions, the systematics and predictions of mixing effects in the thermodynamics of aqueous electrolyte solutions are not well established, particularly at high temperatures. The most useful general method for studying the excess Gibbs energy of mixed electrolyte solutions is the isopiestic technique but some calorimetric methods have desirable advantages provided suitable reference data are available. Currently, the most useful description of mixed electrolyte systems is the ion-interaction treatment of Pitzer. Relationships between various models used for mixtures and their advantages and disadvantages are discussed. Mixing contributions have their largest effect for equimolar mixtures in the case of the osmotic coefficient and for trace components in the case of activity coefficients. Various types of behavior are illustrated with examples primarily from high-temperature isopiestic studies at ORNL. 42 refs., 4 figs.

**34603** (CONF-911088–1) **An experimental study of the volatility of ammonium chloride from aqueous solutions to high temperatures.** Simonson, J.M.; Palmer, D.A. Oak Ridge National Lab., TN (United States). [1991]. 12p. Sponsored by Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC05-84OR21400. From 52. international water conference; Pittsburgh, PA (United States); 21-23 Oct 1991. Order Number DE91017875. Source: OSTI; NTIS; GPO Dep.

The EPRI fossil plant cycle chemistry monitoring project has provided detailed chemical analytical results for the water and steam cycles of four US power plants. The results for the calculated chemical carryover of chloride were correlated with the expected ammonium chloride volatility in those plants using all-volatile treatment (AVT). It was found that chloride levels observed in the high-temperature steam are significantly higher than predicted on the basis of the commonly-used plots of solute volatility ratios, expressed as log {(ppm in vapor)/(ppm in liquid)} plotted against the logarithm of the density ratio of steam to liquid. The goal of the present project, undertaken at the request of EPRI, is to determine quantitatively the partitioning of chloride over aqueous solutions under conditions similar to those of AVT steam generators. A further goal is the determination of liquid-vapor partitioning ratios at lower temperatures, appropriate to the conditions found in steam turbines, and particularly those temperature and pressure conditions near the Wilson line.

**34604** (DOE/ER/13295–5) **[Transition metal mediated transformations of small molecules]: Annual progress report, December 1, 1990–November 30, 1991.** Sen, Ayusman. Pennsylvania State Univ., University Park, PA (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13295. Order Number DE91018807. Source: OSTI; NTIS; GPO Dep.

We have succeeded in extending the palladium(2) catalyzed alternating copolyermization of carbon monoxide with olefins to include $\alpha$-olefins. The second aspect of the use of carbon monoxide as a reactive monomer that we have studied is the catalytic synthesis of polyoxamide and polyurea from $\alpha,\omega$-diamines and carbon monoxide. An important application of the new catalysts was in the linear step-growth polymerization of p-divinylbenzene. In order to arrive at an understanding of the elementary steps are involved in the Mo(6) oxide catalyzed oxidation of alkanes and olefins, we have examined the anaerobic and aerobic decomposition routes for Mo(6)-oxoalkyl complexes of the type, $(Me_2\text{-bipy})_2Mo\vee_2(R)_2$. We have investigated the oxidation of ethers by the platinum(2) ion and by metallic platinum in aqueous medium. Finally, we have examined ways to synthesize metal oxide nanoclusters of well-defined sizes in polymeric matrices. 10 refs.

**34605** (DOE/ER/13299–7) **[Diosmacycloalkanes as models for the formation of hydrocarbons from surface methylenes]: Progress report, April 1, 1990–October 31, 1991.** Norton, J.R. Colorado State Univ., Fort Collins, CO (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER13299. Order Number DE91017854. Source: OSTI; NTIS; GPO Dep.

We have developed a method for the preparation of $CH_3CD(OTf)_2$ and $CD_3CD(OTf)_2$, and have used them for the preparation of $Os_2(CO)_8(\mu\text{-}CDCH_3)$ and $Os_2(CO)_8(\mu\text{-}CDCD_3)$. We have examined the mechanism of the extrusion of propene from a diosmacyclobutane. It is clear that the majority of the product is formed by the expected $\beta$ elimination. However, the formation of a significant amount of $CH_3CD{=}CHD$ shows that, contrary to the conventional wisdom, some $\alpha$ elimination is occurring. We investigating the mechanism of olefin and acetylene exchange with diosmacyclobutanes. We have also discovered a novel allenyl "Claisen" rearrangement while exploring the reactions of an 1(3) reagent with triple bonds. Finally, we have learned that a side chain ether oxygen can control the regioselectivity with which the reagent adds to triple bonds. 2 refs.

**34606** (DOE/ER/13564–10) **Controlled synthesis of polyenes by catalytic methods: Progress report, August 1, 1990–July 31, 1991.** Schrock, R.R. Massachusetts Inst. of Tech., Cambridge, MA (United States). [1991]. 4p. Sponsored by USDOE,

Washington. DC (United States). DOE Contract FG02-86ER13564. Order Number DE91018804. Source: OSTI; NTIS; GPO Dep.

A study concerned with the controlled synthesis of polyenes by ring opening metathesis polymerization using tricyclo[4.2.2.$0^{2,5}$]deca-3,7,9-trienes (TCDT's) and a molybdenum catalyst (Mo(CH-t-Bu)(NAr)(O-t-Bu)$_2$; Ar = 2,6-$C_6H_3$-i-$Pr_2$) has now appeared. We have continued to search for a catalyst that will polymerize terminal acetylenes in a regiospecific manner. Recent applications of polyparaphenylenevinylenes include photo and electroluminescence. We would like to prepare polyparaphenylenevinylenes and related materials for evaluation in similar applications. 7 refs.

**34607** (DOE/ER/13582–5) **Study of improved methods for predicting chemical equilibria: Technical progress report, September 1, 1990–August 31, 1991.** Lenz, T.G. (Colorado State Univ., Fort Collins, CO (United States). Dept. of Chemical Engineering); Vaughan, J.D. Colorado State Univ., Fort Collins, CO (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER13582. Order Number DE91018803. Source: OSTI; NTIS; GPO Dep.

The objective of the research during the current and preceding periods has been to calculate thermodynamic properties ($\triangle H°$, $\triangle S°$, and $\triangle G°$) of typical organic reactions in the gas and solution phases with sufficient accuracy to provide a viable alternative to expensive, time-consuming laboratory experimentation. The research has proceeded along five pathways. (1) Calculation of the thermodynamic properties $\triangle H_f°$, $C_p°$,$(H° - H_o°)/T$, and $S°$ for reactants and products in the gas phase. (2) Transformation of gas phase thermodynamic properties of reactants and products into condensed phase properties by use of observed vapor pressure data. (3) Experimental determination of X-ray crystal structures, vapor and sublimation pressures, and calorimetric standard enthalpies of formation of large, relatively complicated reactants and products, such as Diels-Alder adducts of substituted anthracenes and substituted maleic anhydrides. (4) Experimental determination of equilibrium constants of Diels-Alder reactions of complicated strained dienes and dienophiles over a range of temperatures in liquid solution. (5) Molecular dynamics study of pure liquids and liquid mixtures to eventually permit new activity coefficient models being developed. 4 tabs., 22 refs.

**34608** (DOE/ER/13865–042) **A study of lanthanide fluorescence shifts caused by near neighbor perturbation.** Stump, N.A. Tennessee Univ., Knoxville, TN (United States). Dec 1991. 120p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER13865 ;AC05-84OR21400. Order Number DE91018532. Source: OSTI; NTIS; GPO Dep.

Lanthanide ions, unlike ions formed by the d-block elements, characteristically exhibit narrow electronic spectral features, usually on the order of one to two wavenumbers. The spectral position and intensity of these features are dependent upon the environmental symmetry of the lanthanide ion. Any perturbation in the coordination sphere, such as a change in bond distance, or a shift to another geometrical polyhedron, will ordinarily cause a change in the observed spectrum. These two characteristics (narrow line spectra and environmental sensitivity) make the lanthanide ions particularly useful for the study of symmetry, coordination, and crystal structure in solid and dissolved compounds in which they are a major or a minor constituent. Such compounds could also be employed for the study of impurities, coordination numbers, absorption of solvent molecules, and anything else that might perturb the environment around the lanthanide ion. The present work describes the theoretical background required, the instrumentation employed, the syntheses attempted, and the spectral evaluations completed for several europium-containing molecules. A special emphasis was placed upon europium-containing chelates. Europium was chosen because of its simple-appearing electronic spectrum and its readily excited emission in the visible region of the electromagnetic spectrum. 29 refs., 44 figs., 13 tabs.

**34609** (DOE/ER/13933–2) **[Quantum state resolved desorption of CO from solid surface]: [Progress report], June 15, 1988–June 15, 1991.** Pittsburgh Univ., PA (United States). Dept. of Chemistry. [1991]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13933. Order Number DE91017712. Source: OSTI; NTIS; GPO Dep.

In this project we have concentrated on three activities. First, we studied the kinetics of recombinative desorption of hydrogen and deuterium atoms on a Si(100) surface. Second, we studied the kinetics of isotope mixing between CO molecules on a potassium promoted Ni(111) surface. Third, we have designed and implemented a laser multiphoton ionization time-of-flight (MPI-TOF) mass spectrometer for measuring the velocity, vibrational and rotational distribution of molecules leaving a surface in our ultrahigh vacuum chamber. 7 figs.

**34610** (DOE/ER/14146–1) **[Electron transfer activation of coordinated thiophene].** Rauchfuss, T.B. Illinois Univ., Urbana, IL (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER14146. Order Number DE91017729. Source: OSTI; NTIS; GPO Dep.

This report summarizes our recent work on the isolation, characterization, and thermolysis of an intermediate in a thiophene desulfurization reaction. In the thermolysis, two metals combine to stabilize the $C_4$ hydrocarbon residue in the form of a ferrole while three metals bind the extruded sulfur atom to give a cluster. Thus the metals play two distinct roles in the desulfurization of the heterocycle. The initial stage in thiophene desulfurization constitutes the replacement of one heteroatom with another, i.e. metal for sulfur. The metallacyclic ferrole provides an obvious means for the stabilization of the hydrocarbon residue. With regard to subsequent steps in a hydrodesulfurization cycle, the formation of M-C bonds is necessary simply because they are susceptible to hydrogenolysis whereas C-S bonds are not.

**34611** (ETDE/JP-mf–2709570) **Report on the National Research Institute for Pollution and Resources. No. 48.: Fundamental studies on the decomposition of organic compounds having low molecular weight by the combined use of ozone oxidation method and electrolytic method.** Takahashi, N. (National Research Institute for Pollutin and Resources, Tsukuba (Japan)); Katsuki, O.; Hirai, M.; Kato, Y.; Murayama, K.; Wada, S.; Nakai, T.; Sato, Y.; Tatsumi, K.; Ichikawa, H. National Research Inst. for Pollution and Resources, Tsukuba, Ibaraki (Japan). 29 Mar 1991 116p. (In Japanese). Order Number DE92709570. Source: OSTI; NTIS (US Sales Only).

The electrolytic method by the combined use of ozone oxidation method is taken up, for the purpose of completely decomposing organic compounds of low molecular weight, which remain in the aqueous solution still after ozone oxidation, up to $H_2O$ and $CO_2$. Studies are made on various fundamental characteristics in the combined use of an ozone oxidation method and an electrolytic method. Moreover, comparisons are made with ozone oxidation under the ultraviolet irradiation to clarify basic characteristics on the analysis of low-molecular-weight organic ocmpounds. Further studies are made on characteristics in applicability and economic evaluation. This study is composed of eight chapters. Through them, knowledge and information are obtained and clarified of various characteristics on decomposition of low-molecular-weight organic compounds like reaction mechanism, reaction conditions, reactivity and also on applicability and economic efficiency. 187 refs., 74 figs., 21 tabs.

**34612** (INIS-SU–253/A, pp. 388) **X-ray diffraction study of metal alcoholates.** Struchkov, Yu.T. (AN SSSR, Moscow (USSR). Inst. Ehlementoorganicheskikh Soedinenij); Yanovskij, A.I.; Turova, N.Ya.; Turevskaya, E.P.; Kessler, V.G. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/molecular structure; CADMIUM COMPLEXES/x-ray diffraction; CESIUM COMPLEXES/molecular structure; CESIUM COMPLEXES/x-ray diffraction;

MOLYBDENUM COMPLEXES/molecular structure; MOLYBDENUM COMPLEXES/x-ray diffraction; NIOBIUM COMPLEXES/molecular structure; NIOBIUM COMPLEXES/x-ray diffraction; ALKOXIDES; POLYMERS

**34613** (INIS-SU–253/A, pp. 389) **Role of hydrogen bonds in reactivity of nitroso complexes.** Nikol'skij, A.B. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)); Veletskij, N.I.; Ershov, A.Yu. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RUTHENIUM COMPLEXES/chemical bonds; RUTHENIUM COMPLEXES/chemical properties; BIPYRIDINES; CHEMICAL COMPOSITION; HALIDES; NITROSO COMPOUNDS

**34614** (INIS-SU–253/A, pp. 390) **Fragment analysis and X-ray spectra of complexes.** Murakhtanov, V.V. (AN SSSR, Novosibirsk (USSR). Inst. Neorganicheskoj Khimii); Mazalov, L.N. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BORON COMPLEXES/electronic structure; BORON COMPLEXES/x-ray spectra; RUTHENIUM COMPLEXES/electronic structure; RUTHENIUM COMPLEXES/x-ray spectra; CHEMICAL COMPOSITION; EMISSION SPECTRA

**34615** (INIS-SU–253/A, pp. 391) **Polynuclear cluster compounds with systems of metal-metal delocalized bonds of high multiplicity.** Kryuchkov, S.V. (AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii). AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MOLYBDENUM COMPLEXES/chemical preparation; MOLYBDENUM COMPLEXES/electronic structure; RHENIUM COMPLEXES/chemical preparation; RHENIUM COMPLEXES/electronic structure; TECHNETIUM COMPLEXES/chemical preparation; TECHNETIUM COMPLEXES/electronic structure; TUNGSTEN COMPLEXES/chemical preparation; TUNGSTEN COMPLEXES/electronic structure; CHEMICAL BONDS; MOLECULAR STRUCTURE

**34616** (INIS-SU–253/A, pp. 392) **Synthesis and structure of four heterometallic V, Nb and W-containing complexes - $Fe_2S_2(CO)_6$ derivatives.** Katser, S.B.; Kolobkov, B.I.; Pasynskij, A.A.; Antsyshkina, A.S. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NIOBIUM COMPLEXES/chemical preparation; NIOBIUM COMPLEXES/molecular structure; TUNGSTEN COMPLEXES/chemical preparation; TUNGSTEN COMPLEXES/molecular structure; VANADIUM COMPLEXES/chemical preparation; VANADIUM COMPLEXES/molecular structure; CARBONYLS; CHEMICAL COMPOSITION; CYCLOPENTADIENE; IRON COMPLEXES; SULFIDES

**34617** (INIS-SU–253/A, pp. 394) **Copper borohydride complexes: synthesis, structure, properties.** Makhaev, V.D. (AN SSSR, Chernogolovka (USSR). Inst. Novykh Khimicheskikh Problem); Borisov, A.P. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BOROHYDRIDES/chemical preparation; BOROHYDRIDES/molecular structure; BOROHYDRIDES; CHEMICAL COMPOSITION; COPPER COMPLEXES; DECOMPOSITION; ORGANIC PHOSPHORUS COMPOUNDS

**34618** (INIS-SU–253/A, pp. 397) **Molybdenum and tungsten complexing in sodium metaphosphate base melts.** Bandur, V.A. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Obshchej i Neorganicheskoj Khimii); Bezarashvili, L.R.; Buryak, N.I.; Volkov, S.V. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MOLYBDENUM COMPLEXES/chemical preparation; TUNGSTEN COMPLEXES/chemical preparation; CHEMICAL COMPOSITION; HIGH TEMPERATURE; MOLECULAR STRUCTURE; MOLTEN SALTS; MOLYBDENUM OXIDES; SODIUM CHLORIDES; SODIUM PHOSPHATES; TUNGSTEN OXIDES

**34619** (INIS-SU–253/A, pp. 402) **Reactions of binuclear ruthenium (2,3) sulfate with metal-metal bond.** Zhilyaev, A.N.; Fomina, T.A.; Katser, S.B. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RUTHENIUM COMPLEXES/chemical reaction kinetics; ACETONITRILE; CHEMICAL BONDS; HYDRATES; KETONES; MOLECULAR STRUCTURE; POTASSIUM COMPOUNDS; PYRIDAZINES; SULFATES

**34620** (INIS-SU–253/A, pp. 405) **Synthesis, structure and properties of complexes of zinc tetrahydroborate with tetrahydroborates of organic cations.** Makhaev, V.D. (AN SSSR, Chernogolovka (USSR). Inst. Novykh Khimicheskikh Problem); Borisov, A.N.; Antsyshkina, A.S.; Saidov, B.I.; Mal'tseva, N.N.; Kedrova, N.S. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk

(Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR). 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BOROHYDRIDES/chemical preparation; BOROHYDRIDES/crystal structure; BOROHYDRIDES; CHEMICAL COMPOSITION; LATTICE PARAMETERS; MOLECULAR STRUCTURE; ORGANIC PHOSPHORUS COMPOUNDS; ZINC COMPLEXES

**34621** (INIS-SU–253/A, pp. 406) **Correlation between stereochemistry and circular dichroism spectra of transition metal chiral binuclear clusters.** Klyagina, A.P.; Golovaneva, I.F.; Sadikov, G.G.: Levin, A.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MOLYBDENUM COMPLEXES/dichroism; MOLYBDENUM COMPLEXES/stereochemistry; AMINO ACIDS; CHEMICAL COMPOSITION; CORRELATIONS; ELECTRONIC STRUCTURE; MANDELIC ACID; DICHROISM; STEREOCHEMISTRY; SPECTRA; THIOCYANATES

**34622** (INIS-SU–253/A, pp. 412) **Mo(6) complexonates with 1-hydroxyethylidenediphosphonic acid ($H_4L$).** Tolkacheva, E.O. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Khimicheskikh Reaktivov i Osobo Chistykh Veshchestv, Moscow (USSR)); Popov, K.I.; Dyatlova, N.M. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. MOLYBDENUM COMPLEXES/chemical preparation; MOLYBDENUM COMPLEXES/molecular structure; ALKALI METAL COMPOUNDS; AMMONIUM COMPOUNDS; AQUEOUS SOLUTIONS; CHELATES; CHEMICAL COMPOSITION; HYDRATES; PH VALUE; PHOSPHONIC ACID ESTERS

**34623** (INIS-SU–253/A, pp. 413) **Similarity and differences of structure, stability and structural nonrigidity of metal borohydrides and aluminohydrides.** Zyubin, A.S. (AN SSSR, Chernogolovka (USSR). Otdelenie Inst. Khimicheskoj Fiziki); Charkin, O.P. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BERYLLIUM COMPOUNDS/dissociation energy; BERYLLIUM COMPOUNDS/molecular structure; BOROHYDRIDES/dissociation energy; BOROHYDRIDES/molecular structure; ATOMIC NUMBER; BINDING ENERGY; BOROHYDRIDES; CHEMICAL COMPOSITION

**34624** (INIS-SU–253/A, pp. 417) **Electronic structure of Be and Mg oxo-complexes from quantum-chemical calculation data.** Rykova, E.A. (Moskovskij Aviatsionnyj Inst., Moscow (USSR)); Klimenko, N.M.; Grigor'ev, A.I. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 2 refs. BERYLLIUM COMPLEXES/electronic structure; BOND LENGTHS; CHEMICAL COMPOSITION; DISSOCIATION HEAT; LIGANDS; OXIDES; STABILITY

**34625** (INIS-SU–253/A, pp. 420) **Structure of metal coordination compounds with hydrazides containing different functional groups.** Sinditskij, V.P. (Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR)); Sokol, V.I.; Dutov, M.D.; Fogel'zang, A.E.; Poraj-Koshits, M.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/molecular structure; CHEMICAL COMPOSITION; CHEMICAL PREPARATION; HYDRAZIDES; PERCHLORATES; TETRAZOLES

**34626** (INIS-SU–253/A, pp. 423) **Synthesis and crystal structure of copper and cadmium coordination compounds with isomeric 1- and 2-substituted tetrazoles.** Sokol, V.I. (Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR)); Sinditskij, V.P.; Dutov, M.D.; Fogel'zang, A.E.; Poraj-Koshits, M.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/chemical preparation; CADMIUM COMPLEXES/crystal structure; BOND LENGTHS; CHELATES; CHEMICAL COMPOSITION; HYDRAZIDES; PERCHLORATES; TETRAZOLES

**34627** (INIS-SU–253/A, pp. 424) **Features of structure of anion rare earth complexes with ethylenediaminetetraacetic, fluoride and carbonate ligands.** Mistryukov, V.Eh.; Zhuraviev, M.G.; Sergeev, A.V.; Mikhajlov, Yu.N.; Shchelokov, R.N. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPLEXES/crystal structure; RARE EARTH COMPLEXES/molecular structure; URANIUM COMPLEXES/crystal structure; URANIUM COMPLEXES/molecular structure; YTTRIUM COMPLEXES/crystal structure; YTTRIUM COMPLEXES/molecular structure; CHEMICAL PREPARATION;

COORDINATION NUMBER; EDTA; FLUORIDES; GUANIDINES; HYDRATES; INTERATOMIC DISTANCES

**34628** (INIS-SU–253/A, pp. 432) **Sensitization effect in rare earth complexes on the basis of aprotic inorganic solvents.** Aslanov, L.A.; Gilyarov, O.N.; Krasilov, Yu.I.; Kulikovskij, B.N.; Novoderezhkina, T.L.; Seregina, E.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. RARE EARTH COMPLEXES/luminescence; RARE EARTH COMPLEXES/sensitizers; ZIRCONIUM COMPLEXES/luminescence; ZIRCONIUM COMPLEXES/sensitizers; CHEMICAL COMPOSITION; CHEMICAL PREPARATION; CHLORINE COMPOUNDS; MOLECULAR STRUCTURE; OXYGEN COMPOUNDS; PHOSPHORUS COMPOUNDS; LUMINESCENCE; SENSITIZERS

**34629** (INIS-SU–253/A, pp. 434) **Heteronuclear complexing in $AlCl_3$-$MgCl_2$-LiCl-KCl and $ZnCl_2$-$CdCl_2$-LiCl-KCl melts.** Volkov, S.V. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Obshchej i Neorganicheskoj Khimii); Buryak, N.I.; Babushkina, O.B. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/chemical preparation; CHEMICAL COMPOSITION; CHLORIDES; MOLECULAR STRUCTURE; MOLTEN SALTS; RAMAN SPECTRA; ZINC COMPLEXES

**34630** (INIS-SU–253/A, pp. 435) **Structure, complexing abilities of triazole- and tetrazole-containing azomethines.** Kuznetsova, L.I. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR). Nauchno-Issledovatel'skij Inst. Fizicheskoj i Organicheskoj Khimii); Burlov, A.S. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/chemical preparation; CADMIUM COMPLEXES/molecular structure; AROMATICS; CHEMICAL COMPOSITION; SCHIFF BASES; TETRAZOLES

**34631** (INIS-SU–253/A, pp. 436) **Effect of secondary cations on structure of dimolybdatouranylate complexes.** Kim Zen Kho; Krasovskaya, T.I.; Malyarevich, A.M.; Posledovich, M.R. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MOLYBDATES/crystal structure; MOLYBDATES/molecular structure; URANYL COMPLEXES/crystal structure; URANYL COMPLEXES/molecular structure; ALKALI METAL COMPOUNDS; MOLYBDATES; RAMAN SPECTRA

**34632** (INIS-SU–253/A, pp. 441) **Ambidenticity of amides in indium (3) fluorocomplexes.** Petrosyants, S.P.; Malyarik, M.A.; Buslaev, Yu.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. INDIUM COMPLEXES/chemical preparation; INDIUM COMPLEXES/molecular structure; ACETAMIDE; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; FLUORIDES; ISOMERS; THIOUREA; UREA

**34633** (INIS-SU–253/A, pp. 443) **Instability of structure of polynuclear vanadium (5) oxocomplexes.** Terekhov, A.G. (AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Metallurgii i Obogashcheniya). AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 3 refs. VANADIUM COMPLEXES/crystal structure; VANADIUM COMPLEXES/polymerization; ANIONS; CHEMICAL COMPOSITION; INORGANIC POLYMERS; MOLECULAR STRUCTURE; OXIDES; STABILITY; VALENCE; POLYMERIZATION

**34634** (INIS-SU–253/A, pp. 454) **Aluminohydride complexes of samarocene and lutetocene.** Solovejchik, G.L. (AN SSSR, Chernogolovka (USSR). Otdelenie Inst. Khimicheskoj Fiziki); Knyazhanskij, S.Ya.; Gun'ko, Yu.K.; Bel'skij, V.K.; Bulychev, B.M. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 2 refs. LUTETIUM COMPLEXES/chemical preparation; LUTETIUM COMPLEXES/crystal lattices; SAMARIUM COMPLEXES/chemical preparation; SAMARIUM COMPLEXES/crystal lattices; ALUMINIUM COMPOUNDS; CHEMICAL COMPOSITION; CYCLOPENTADIENE; HYDROGEN COMPOUNDS; LATTICE PARAMETERS; MOLECULAR STRUCTURE; SOLVATION

**34635** (INIS-SU–253/A, pp. 458) **Spectrochemical study of platinum (4) hexaiodates with different second-sphere cations.** Belicheva, T.G. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)); Kononova, M.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3:*

*Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. IODATES/crystal structure; IODATES/molecular structure; ALKALI METAL COMPOUNDS; AMMONIUM COMPOUNDS; CHEMICAL COMPOSITION; IODATES; PLATINUM COMPLEXES; PYROLYSIS; STABILITY; VIBRATIONAL STATES

**34636** (INIS-SU–253/A, pp. 463) **Structure of $Cd^{2+}$ hydrate complexes in cadmium sulfate aqueous solutions from the data on X-ray diffraction.** Smirnov, P.R. (Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR)); Trostin, V.N. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. CADMIUM COMPLEXES/crystal structure; CADMIUM COMPLEXES/molecular structure; AQUEOUS SOLUTIONS; CADMIUM SULFATES; HYDRATES

**34637** (INIS-SU–253/A, pp. 465) **Structure of three monooxychloride transition metal complexes with 18-crown-6.** Minacheva, L.Kh. (Tadzhikskij Gosudarstvennyj Univ., Dushanbe (USSR)); Sergienko, V.S.; Ashurova, N.Kh.; Borzunov, V.K.; Yakubov, K.G. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MOLYBDENUM COMPLEXES/crystal structure; RHENIUM COMPLEXES/crystal structure; VANADIUM COMPLEXES/crystal structure; BOND LENGTHS; HETEROCYCLIC COMPOUNDS; HYDRATES; MOLECULAR STRUCTURE; OXYCHLORIDES; POLYETHYLENE GLYCOLS

**34638** (INIS-SU–253/A, pp. 472) **Structural features of palladium, manganese, cadmium and cobalt complexes with pyrazole derivatives.** Lipnitskij, I.V.; Skutov, I.K. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/molecular structure; CHLORIDES; HYDRATES; PYRAZOLES; VIBRATIONAL STATES

**34639** (INIS-SU–253/A, pp. 476) **Study of boron complexing with hydroxyethylidenediphosphonic acid by the $^{11}B$, $^{31}P$ NMR method.** Kostromina, N.A. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Obshchej i Neorganicheskoj Khimii); Tret'yakova, I.N.; Novikova, L.B.; Trachevskij, V.V. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BORON COMPLEXES/chemical preparation; CHEMICAL COMPOSITION; HYDROXIDES; MOLECULAR STRUCTURE; PHOSPHONIC ACID ESTERS

**34640** (INIS-SU–253/A, pp. 477) **Polynuclear complexing: relation of stereoeffects and structure.** Chevela, V.V. (Kazanskij Gosudarstvennyj Univ., Kazan (USSR)); Vul'fson, S.G.; Matveev, S.N.; Semenov, V.Eh.; Bezryadin, S.G.; Vagizova, G.Ya. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ZIRCONIUM COMPLEXES/chemical preparation; ZIRCONIUM COMPLEXES/stereochemistry; ALUMINIUM COMPLEXES; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; MOLECULAR STRUCTURE; TARTRATES; TIN COMPLEXES; STEREOCHEMISTRY

**34641** (INIS-SU–253/A, pp. 478) **Complexing properties of amphiphilic ion exchangers modified with fatty acid anions.** Kharevich, O.F. (Belorusskij Politekhnicheskij Inst., Minsk (Byelorussian SSR)); Zimina, I.F.; Matvejko, N.P. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/chemical preparation; CADMIUM COMPLEXES/chemisorption; CHEMISORPTION; CARBOXYLIC ACID SALTS; CHEMICAL COMPOSITION; CHEMICAL REACTION KINETICS; ORGANIC ION EXCHANGERS

**34642** (INIS-SU–253/A, pp. 481) **Synthesis and study of rare earth tris-tetraethyliminodiphosphates.** Gudima, A.O. (Kievskij Gosudarstvennyj Univ., Kiev (Ukrainian SSR)); Rudzevich, V.L. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPLEXES/chemical preparation; RARE EARTH COMPLEXES/crystal structure; CHEMICAL COMPOSITION; LATTICE PARAMETERS; MOLECULAR STRUCTURE; PHOSPHORIC ACID ESTERS

**34643** (INIS-SU–253/A, pp. 484) **Investigation of rare metal ion complexing with butylphenolformaldehyde oligomers by spectroscopy methods.** Ksenofontov, M.A. (Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). Inst. Prikladnykh Fizicheskikh Problem); Rogalevich, N.L.; Yakovlev, A.B.; Bukin, V.I. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk

(USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. TANTALUM COMPLEXES/molecular structure; ELECTRON SPECTRA; INFRARED SPECTRA; OXALATES; PHENOLS; POLYOXYMETHYLENES

**34644** (INIS-SU–253/A, pp. 485) **Oxovanadium complexing with oxalic acid thioderivatives in pyridine-aqueous and aqueous solutions.** Marov, I.N. (AN SSSR, Moscow (USSR). Inst. Geokhimii i Analiticheskoj Khimii); Kalinichenko, N.B. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. VANADIUM COMPLEXES/chemical preparation; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; HYDRATES; ISOMERS; ORGANIC SULFUR COMPOUNDS; OXALATES; OXIDES; PYRIDINES

**34645** (INIS-SU–253/A, pp. 487) **Investigation of molybdenum (0) bisarene complexes in vapour phase by the method of electron absorption spectroscopy.** Ketkov, S.Yu.; Domrachev, G.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. MOLYBDENUM COMPLEXES/electronic structure; MOLYBDENUM COMPLEXES/molecular structure; ABSORPTION SPECTRA; BENZENE; ELECTRON SPECTRA; MESITYLENE; TOLUENE; VAPORS; XYLENES

**34646** (INIS-SU–253/A, pp. 489) **Semlempirical calculation of d-d spectra of transition metal hexaaquacomplexes with local account of electron correlation.** Sudakov, A.V. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Chugreev, A.L.; Misurkin, I.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. VANADIUM COMPLEXES/electronic structure; D STATES; ELECTRON CORRELATION; ENERGY-LEVEL TRANSITIONS; HYDRATES

**34647** (INIS-SU–253/A, pp. 497) **Intermolecular interactions in solutions of rare earth complexes with triketones.** Zheltvaj, I.I. (AN Ukrainskoj SSR, Odessa (Ukrainian SSR). Fiziko-Khimicheskij Inst.). AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPLEXES/configuration interaction; ADDUCTS; CHELATES; CHEMICAL COMPOSITION; KETONES; LIGANDS; OSCILLATOR STRENGTHS; SOLUTIONS

**34648** (INIS-SU–253/A, pp. 498) **Spectral study of interionic interactions, structure and dynamics of anions in some complex fluorides.** Ignat'eva, L.N. (AN SSSR, Vladivostok (USSR). Inst. Khimii); Sergienko, V.I.; Antokhina, T.F. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 fig. CESIUM COMPOUNDS/configuration interaction; CESIUM COMPOUNDS/ion mobility; ANTIMONY COMPLEXES; ELECTRONIC STRUCTURE; FLUORIDES; GERMANIUM COMPLEXES; INFRARED SPECTRA; SILICON COMPLEXES; TIN COMPLEXES; VIBRATIONAL STATES

**34649** (INIS-SU–253/A, pp. 505) **Study of different-ligand vanadium coplexes with chromophore reagents of anthraquinone series and cationic surfactants.** Tashuta, G.N. (AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Metallurgii i Obogashcheniya); Blokh, M.Sh.; Babenko, N.L. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. VANADIUM COMPLEXES/chemical composition; VANADIUM COMPLEXES/chemical preparation; ANTHRAQUINONES; ISOMERS; POLYPHENOLS; STABILITY; SURFACTANTS

**34650** (INIS-SU–253/A, pp. 513) **Rhenium (5) oxohalide complexes with thiosemicarbazide.** Amindzhanov, A.A. (Tadzhikskij Gosudarstvennyj Univ., Dushanbe (USSR)); Kurbanov, N.M. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RHENIUM COMPLEXES/chemical preparation; RHENIUM COMPLEXES/molecular structure; COORDINATION VALENCES; DIAMAGNETISM; HALIDES; HYDRATES; ORGANIC SULFUR COMPOUNDS; OXIDES; PH VALUE; SEMICARBAZIDES

**34651** (INIS-SU–253/A, pp. 514) **Intramolecular tellurium-nitrogen coordination bond in 2-butyltellurobenzalanilines.** Movshovich, D.Ya. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR). Nauchno-Issledovatel'skij Inst. Fizicheskoj i Organicheskoj Khimii); Ivanova, N.A.; Bulgarevich, S.B.; Maksimenko, A.A.; Maslakov, A.G.; Sadekov, I.D. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR).

1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. TELLURIUM COMPLEXES/molecular structure; AMINES; AROMATICS; CHEMICAL BONDS; DIOXANE; DIPOLE MOMENTS; KERR EFFECT; ORGANOMETALLIC COMPOUNDS; REFRACTIVITY; SOLUTIONS

**34652** (INIS-SU–253/A, pp. 516) **Complexing in iodate systems.** Kuznetsov, V.V. (Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR)); Trostin, V.N. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. IODATES/aqueous solutions; IODATES/chemical reaction kinetics; HYDRATION; IODATES; MEDIUM TEMPERATURE; SODIUM COMPOUNDS; X-RAY DIFFRACTION

**34653** (INIS-SU–253/A, pp. 517) **Vanadium (5) and iron (3) complexes with Meerwein ester, their structure and analytical features.** Nabivanets, B.I. (Kievskij Politekhnicheskij Inst., Kiev (Ukrainian SSR)); Knyazeva, E.N.; Klimenko, E.P.; Dovgan', N.L.; Trachevskij, V.V. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. VANADIUM COMPLEXES/chemical preparation; VANADIUM COMPLEXES/molecular structure; ALCOHOLS; AQUEOUS SOLUTIONS; CARBOXYLIC ACID ESTERS; KETONES; PH VALUE

**34654** (INIS-SU–253/A, pp. 518) **Structural features of aqueous solutions of sodium chromate and tungstate from X-ray diffraction data.** Vinogradov, E.V. (Ivanovskij Khimiko-Tekhnologicheskij Inst., Ivanovo (USSR)); Trostin, V.N.; Krestov, G.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. SODIUM TUNGSTATES/hydration; AQUEOUS SOLUTIONS; MEDIUM TEMPERATURE; QUANTITY RATIO; HYDRATION

**34655** (INIS-SU–253/A, pp. 521) **Features of thiosulfate ion complexing with metals.** Rodina, E.P.; Trachevskij, V.V. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/chemical preparation; MOLYBDENUM COMPLEXES/chemical preparation; VANADIUM COMPLEXES/chemical preparation; CHEMICAL COMPOSITION; CHEMICAL REACTION KINETICS; MOLECULAR STRUCTURE; THIOSULFATES

**34656** (INIS-SU–253/A, pp. 529) **Study of complexes formed with complexones of aminocarboxylic and aminophosphonic series by $^{13}C$ and $^{31}P$ NMR method with the use of paramagnetic selective relaxants.** Popov, K.I. (Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Khimicheskikh Reaktivov i Osobo Chistykh Veshchestv, Moscow (USSR)); Vendilo, A.G.; Kovaleva, N.E.; Tolkacheva, E.O.; Larchenko, V.E.; Batalova, T.P.; Sejfullina, I.I.; Kaslina, N.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. LANTHANUM COMPLEXES/molecular structure; VANADIUM COMPLEXES/molecular structure; AQUEOUS SOLUTIONS; CHELATES; COORDINATION VALENCES; DTPA; EDTA; GADOLINIUM COMPLEXES; NMR SPECTRA; PHOSPHONIC ACID ESTERS

**34657** (INIS-SU–253/A, pp. 530) **Correlation of spectral properties of lanthanide $\beta$-diketonates with ligand structure.** Topilova, Z.M. (AN Ukrainskoj SSR, Odessa (Ukrainian SSR). Fiziko-Khimicheskij Inst.); Rusakova, N.V.; Meshkova, S.B.; Gevaza, Yu.I.; Lozinskij. M.O.; Yudanova, I.V.; Kuzmin, V.E. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPLEXES/chemical composition; RARE EARTH COMPLEXES/luminescence; ABSORPTION SPECTRA; KETONES; LIGANDS; MOLECULAR STRUCTURE; ORGANIC FLUORINE COMPOUNDS; LUMINESCENCE

**34658** (INIS-SU–253/A, pp. 532) **Role of structure factor in complexing processes of rare earth ions.** Khripun, M.K. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)); Efimov, A.Yu.; Chervonenko, K.Yu. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NEODYMIUM COMPLEXES/chemical preparation; TERBIUM COMPLEXES/chemical preparation; ABSORPTION SPECTRA; AQUEOUS SOLUTIONS; CHLORIDES; ELECTROLYTES; LUMINESCENCE; MOLECULAR STRUCTURE; QUANTITY RATIO; THIOCYANATES

**34659** (INIS-SU–253/A, pp. 539) **Composition and structure of molybdenum complexes in aqueous and organic media and solid products.** Tarasova, Eh.G. (AN Kazakhskoj SSR, Alma-Ata (USSR). Inst. Metallurgii i Obogashcheniya); Bogomolova, M.M. AN

SSSR. Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR. Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii: AN SSSR. Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii: AN Belorusskoj SSR. Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347--: 17. all-union Chugaev conference on complex compound chemistry. Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only): INIS.

Short note. MOLYBDENUM COMPLEXES/chemical preparation; AMINES; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; MOLECULAR STRUCTURE; ORGANIC ION EXCHANGERS; OXIDES; QUANTITY RATIO; SOLVENT EXTRACTION; SULFATES

**34660** (INIS-SU–253/A, pp. 540) **Coordination compounds of immobile luminescent reagents with rare elements.** Zel'tser, L.E. (Tashkentskij Gosudarstvennyj Univ., Tashkent (USSR)); Bychenko, A.V. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347--: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BERYLLIUM COMPLEXES/chemical preparation; HAFNIUM COMPLEXES/chemical preparation; INDIUM COMPLEXES/chemical preparation; THORIUM COMPLEXES/chemical preparation; ZIRCONIUM COMPLEXES/chemical preparation; ADSORBENTS; ALDEHYDES; AMINES; AZINES; CELLULOSE; FLAVONES; LUMINESCENCE; POLYPHENOLS

**34661** (INIS-SU–253/A, pp. 544) **Effect of rare earth acetylacetonate structure on their behaviour under conditions of vacuum sublimation.** Dzyubenko, N.G. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Zharkova, N.Ya. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347--: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPLEXES/molecular structure; RARE EARTH COMPLEXES/sublimation; YTTRIUM COMPLEXES/molecular structure; ACETYLACETONE; ADDUCTS; CHELATES; CHEMICAL COMPOSITION; DMSO; HYDRATES; SUBLIMATION; VOLATILITY

**34662** (INIS-SU–253/A, pp. 545) **Different-ligand complexes of oxovanadium and their behaviour in alcoholic solutions.** Belyaeva, V.K. (AN SSSR, Moscow (USSR). Inst. Geokhimii i Analiticheskoj Khimii); Turevskaya, E.P.; Marov, I.N.; Turova, N.Ya. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347--: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. VANADIUM COMPLEXES/chemical composition; VANADIUM COMPLEXES/stability; ALCOHOLS; ELECTRON SPIN RESONANCE; OXYBROMIDES; OXYCHLORIDES; SOLUTIONS; SPECTRA; STABILITY

**34663** (INIS-SU–253/A, pp. 547) **Synthesis, properties and crystal structure of double salts on the basis of thiocyanates tris(ethylenediaminates) of some metals.** Petrusenko, S.R. (Kievskij Gosudarstvennyj Univ., Kiev (Ukrainian SSR)); Sinkevich, A.V.; Mazus. M.D. AN SSSR. Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR. Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii: AN SSSR. Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR. Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347--: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/chemical preparation; CADMIUM COMPLEXES/crystal structure; ALKALI METAL COMPOUNDS; AMINES; AMMONIUM COMPOUNDS; LATTICE PARAMETERS; MOLECULAR STRUCTURE; THIOCYANATES

**34664** (INIS-SU–253/A, pp. 548) **Structure of $[Co(DH)_2Py_2]$center dot$[InPy_2Cl_4]$ and $[Co(DfH)_2(4\text{-pic})_2]$center dot$[In(4\text{-pic})_2Cl_4]$ and their electrical properties.** Chumakov, Yu.M. (AN Moldavskoj SSR, Kishinev (USSR). Inst. Prikladnoj Fiziki); Gandzij, M.V.; Tsapkov, V.I.; Bikshkin, V.N. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347--: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. INDIUM COMPLEXES/crystal structure; CHEMICAL COMPOSITION; CHLORIDES; COBALT COMPLEXES; ELECTRICAL PROPERTIES; LATTICE PARAMETERS; MONOCRYSTALS; OXIMES; PYRIDINES

**34665** (INIS-SU–253/A, pp. 550) **Structure of polycrystalline perrhenates from $^{185,187}Re$ NQR data.** Burtsev, M.Yu.; Kravchenko, Eh.A.; Matyushkov, A.G.; Kotel'nikova, A.S. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347--: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPOUNDS/crystal structure; LUTETIUM COMPOUNDS/crystal structure; PERRHENATES/crystal structure; STRONTIUM COMPOUNDS/crystal structure; HYDRATES; NUCLEAR QUADRUPOLE RESONANCE; PERRHENATES; POLYCRYSTALS; SPECTRA

**34666** (INIS-SU–253/A, pp. 551) **Structure and state of molybdenyl (6) complexes with some diols in nonpolar solvents.** Chichirova, N.D. (Kazanskij Gosudarstvennyj Univ., Kazan (USSR)); Antipina, E.A.; Abdullin, I.R.; Sal'nikov, Yu.I. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347--: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MOLYBDENUM COMPLEXES/chemical state; MOLYBDENUM COMPLEXES/molecular structure; DIOXANE; GLYCOLS; HEXANE; OXIDES; POLYMERIZATION; SOLUTIONS

**34667** (INIS-SU–253/A, pp. 556) **Transition metal ion complexing with polyoxomolybdate $[Al(OH)_6Mo_6O_{18}]^{3-}$ according to $^{17}O$ and $^{95}Mo$ NMR, M=$Zn^{2+}$-$Mn^{2+}$.** Fedotov, M.A. (AN SSSR, Novosibirsk (USSR). Inst. Kataliza); Gavrilina, L.O.; Tat'yanina, I.V.; Torchenkova, E.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. MOLYBDENUM COMPOUNDS/chemical preparation; ALUMINIUM COMPOUNDS; HETEROPOLYANIONS; HYDROXIDES; MOLECULAR STRUCTURE; NMR SPECTRA; TRANSITION ELEMENT COMPLEXES

**34668** (INIS-SU–253/A, pp. 557) **Lanthanide complexes with benzocryptand [2B.2.2].** Korovin, Yu.V. (AN Ukrainskoj SSR, Odessa (Ukrainian SSR). Fiziko-Khimicheskij Inst.); Popkov, Yu.A.; Nazarenko, N.A.; Dotsenko, V.P. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPLEXES/chemical preparation; ABSORPTION SPECTRA; AMINES; CHLORIDES; HETEROCYCLIC COMPOUNDS; HYDRATES; LUMINESCENCE; NMR SPECTRA; POLYETHYLENE GLYCOLS

**34669** (INIS-SU–253/A, pp. 561) **X-ray diffraction and quantum-chemical study of donor-acceptor complexes, $B_{10}H_{12}L_2$.** Polyanskaya, T.M. (AN SSSR, Novosibirsk (USSR). Inst. Neorganicheskoj Khimii); Murakhtanov, V.V. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BORON COMPLEXES/crystal structure; BORON COMPLEXES/molecular structure; ACETONITRILE; AMINES; AMMONIA; BOND ANGLE; BOND LENGTHS; HYDRIDES; ISOMERS; PYRIDINES; SULFIDES

**34670** (INIS-SU–253/A, pp. 562) **Features of structure of hexaaquomagnesium 2-carboxy-8-mercaptoquinolinate tetrahydrate and zirconium and hafnium 2-carboxy-8-mercaptoquinolinates.** Pech, L.Ya. (AN Latvijskoj SSR, Riga (USSR). Inst. Neorganicheskoj Khimii); Bankovskij, Yu.A.; Sobolev, A.N.; Sturis, A.P.; Tetere, I.V. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. HAFNIUM COMPLEXES/crystal structure; HAFNIUM COMPLEXES/molecular structure; ZIRCONIUM COMPLEXES/crystal structure; ZIRCONIUM COMPLEXES/molecular structure; HYDRATES; INTERATOMIC DISTANCES; QUINOLINES; THIOLS

**34671** (INIS-SU–253/A, pp. 564) **On rhenium interaction with thiosalicylic acid and some heterocyclic amines.** Lyapin, S.B. (AN Uzbekskoj SSR, Tashkent (USSR). Inst. Khimii); Talipova, L.L.; Narpiev, N.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. RHENIUM COMPLEXES/chemical preparation; HYDROXY ACIDS; MOLECULAR STRUCTURE; ORGANIC SULFUR COMPOUNDS; PHENANTHROLINE-ORTHO

**34672** (INIS-SU–253/A, pp. 565) **Investigation of triplet state of Gd(3) complexes with 1,10-phenanthroline by MROD method.** Zakharov, V.I. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Kamyshnyj, A.L.; Aslanov, L.A.; Sujsaau, A.P. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 fig. GADOLINIUM COMPLEXES/triplets; FINE STRUCTURE; TRIPLETS; PHENANTHROLINES; PHOSPHORESCENCE; SPECTRA; ULTRALOW TEMPERATURE; VERY LOW TEMPERATURE

**34673** (INIS-SU–253/A, pp. 567) **Possibilities of electron spectroscopy application to study of rare earth compounds coordination polyhedrons in polycrystalline samples.** Batyaev, I.M. (Leningradskij Gosudarstvennyj Pedagogicheskij Inst., Leningrad (USSR)); Batlutskij, V.P. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPLEXES/crystal structure; RARE EARTH COMPLEXES/molecular structure; ABSORPTION SPECTRA; ELECTRON SPECTROSCOPY; HYDRATES; OSCILLATOR STRENGTHS; POLYCRYSTALS

**34674** (INIS-SU–253/A, pp. 573) **Structure of Mo(6) dioxocomplexes with Schiff bases on the basis of acylhydrazones of salicylic aldehyde.** Sergienko, V.S.; Abramenko, V.L.; Minacheva, L.Kh.; Garnovskij, A.D. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MOLYBDENUM COMPLEXES/crystal structure; MOLYBDENUM COMPLEXES/molecular structure; BOND ANGLE;

BOND LENGTHS; CHEMICAL COMPOSITION; ISOMERS; OXIDES; SCHIFF BASES

**34675** (INIS-SU–253/A, pp. 577) **On structure and properties of lanthanide iodide complexes with carbamide and related ligands.** Rukk, N.S. (Moskovskij Inst. Tonkoj Khimicheskoj Tekhnologii, Moscow (USSR)); Alikberova, L.Yu.; Loginova, G.P.; Stepin, B.D.; Zajtseva, M.G.; Van Li. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Sammaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPLEXES/molecular structure; HYDRATES; IODIDES; SOLUBILITY; THIOUREA; UREA

**34676** (INIS-SU–253/A, pp. 578) **Synthesis and properties of volatile $\beta$-diketonates and imino-$\beta$-diketonates of Ca, Sr, Ba and their adducts.** Mazurenko, E.A. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Obshchej i Neorganicheskoj Khimii); Posil'skij, O.A.; Zub, V.Ya.; Subbotina, O.A.; Nabivanets, B.I. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. STRONTIUM COMPLEXES/chemical preparation; STRONTIUM COMPLEXES/volatility; ADDUCTS; AMIDES; CHEMICAL COMPOSITION; DMSO; IMINES; KETONES; MOLECULAR STRUCTURE; VOLATILITY

**34677** (INIS-SU–253/A, pp. 584) **Synthesis and structure of chelates of zinc and rare earths with 2-formylcyclohexanones.** Panyushkin, V.T. (Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR)); Bakhmutskaya, V.G. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPLEXES/chemical preparation; RARE EARTH COMPLEXES/molecular structure; CHELATES; KETONES

**34678** (INIS-SU–253/A, pp. 586) **On structure of interaction products of cobalt, nickel, manganese and iron iodides with carbamide (acetamide) and iodine.** Alikberova, L.Yu. (Moskovskij Inst. Tonkoj Khimicheskoj Tekhnologii, Moscow (USSR)); Zajtseva, M.G.; Rukk, N.S.; Stepin, B.D.; Savinkina, E.V. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. IODIDES/crystal structure; IODIDES/molecular structure; ACETAMIDE; CHEMICAL COMPOSITION; HYDRATES; IODIDES; IODINE; TRANSITION ELEMENT COMPLEXES; UREA

**34679** (INIS-SU–253/A, pp. 587) **Ruthenium complexing with functional groups of POLYORGS sorbents.** Belyaeva, V.K. (AN SSSR, Moscow (USSR). Inst. Geokhimii i Analiticheskoj Khimii); Myasoedova, G.V.; Antokol'skaya, I.I.; Krylova, I.L. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RUTHENIUM COMPLEXES/chemical preparation; CHEMICAL COMPOSITION; HYDROXY COMPOUNDS; IMIDAZOLES; MATRIX MATERIALS; MOLECULAR STRUCTURE; ORGANIC POLYMERS

**34680** (INIS-SU–253/A, pp. 591) **Crystal-structure aspect of boron complex formation with trihydroxyglutaric acid with structures of $Sr_2(NH_4)(C_5H_4O_7)_2B{\cdot}4H_2O$ and $(NH_4)_2Zn_2(H_2O)_2(C_{10}H_6O_{17}B_2)$.** Zviedre, I.I. (AN Latvijskoj SSR, Riga (USSR). Inst. Neorganicheskoj Khimii); Bel'skij, V.K.; Shvarts, E.M. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BORON COMPLEXES/chemical preparation; BORON COMPLEXES/crystal structure; AMMONIUM COMPOUNDS; CHEMICAL COMPOSITION; HYDRATES; MOLECULAR STRUCTURE; STRONTIUM COMPOUNDS; TRIHYDROXYGLUTARIC ACID; ZINC COMPOUNDS

**34681** (INIS-SU–253/A, pp. 599) **Study of nitrogen- and sulfur-containing copolymer complexing with iodine.** Sokolov, A.E.; Rzhevskaya, N.N.; Tsajlingol'd, V.L.; Krejtsberg, V.N.; Rodionova, N.M.; Yablonskij, O.P. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. IODINE COMPLEXES/chemical preparation; CATHODES; COPOLYMERS; ELECTRIC CONDUCTIVITY; ORGANIC SULFUR COMPOUNDS; POLYVINYLS; PYRIDINES

**34682** (INIS-SU–253/A, pp. 600) **Study of complexing processes during alloyage of solid electrolytes by copolymers with silver-iodine-copolymer system as example.** Rzhevskaya, N.N.; Sokolov, A.F.; Tsajlingol'd, V.L.; Krejtsberg, V.N.; Solov'eva, N.A.; Yablonskij, O.P. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3:*

*Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. IODINE COMPLEXES/chemical preparation; COPOLYMERS; ELECTRIC CONDUCTIVITY; ORGANIC SULFUR COMPOUNDS; POLYVINYLS; PYRIDINES; SILVER COMPOUNDS; SOLID ELECTROLYTES

**34683** (INIS-SU–266, pp. 17-18) **Photochemical transformations in heterogeneous system silver-cadmium iodide.** Bolesta, I.M. (L'vovskij Gosudarstvennyj Univ., Lvov (Ukrainian SSR)); Kovalisko, V.I.; Savitskij, D.I.; Futej, A.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. CADMIUM IODIDES/chemical reactions; ABSORPTION SPECTRA; CATHODOLUMINESCENCE; INTERFACES; PHOTOCHEMISTRY; SILVER; ULTRAVIOLET RADIATION

**34684** (INIS-SU–266, pp. 21) **Intensification of ion exchange processes under the action of external fields.** Bobkova, L.A. (Tomskij Gosudarstvennyj Univ., Tomsk (USSR)); Chashina, O.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NEODYMIUM COMPOUNDS/ion exchange; YTTERBIUM COMPOUNDS/ion exchange; CHEMICAL REACTION KINETICS; MAGNETIC FIELDS; ORGANIC ION EXCHANGERS; ULTRASONIC WAVES

**34685** (INIS-SU–266, pp. 173) **Photo- and heat stimulated processes in coordination compounds of metals with dimethyl sulfoxide and dimethyl formamide.** Cherkasova, T.G. (Kuzbasskij Politekhnicheskij Inst., Kemerovo (USSR)); Tatarinova, Eh.S.; Kuznetsova, O.A.; Tryasunov, V.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM COMPLEXES/photolysis; HAFNIUM COMPLEXES/photolysis; INDIUM COMPLEXES/photolysis; RARE EARTH COMPLEXES/photolysis; URANIUM COMPLEXES/photolysis; ZIRCONIUM COMPLEXES/photolysis; AMIDES; PHOTOLYSIS; DMSO; ISOMERIZATION; PYROLYSIS; VISIBLE RADIATION

**34686** (INIS-SU–276) **9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.** AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990 192p. (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers are indexed.

**34687** (INIS-SU–276, pp. 9) **High purity fluorides of elements for fiber optics.** Devyatykh, G.G.; Churbanov, M.F.; Filimonov, I.V. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM FLUORIDES/purification; HAFNIUM FLUORIDES/purification; INDIUM FLUORIDES/purification; LANTHANUM FLUORIDES/purification; YTTRIUM FLUORIDES/purification; ZIRCONIUM FLUORIDES/purification; PURIFICATION; CHEMICAL PREPARATION; FIBER OPTICS; IMPURITIES

**34688** (INIS-SU–276, pp. 10) **Investigation of the mechanism of high purification of zirconium and hafnium tetrafluorides from transition metals.** Ozherel'ev, O.A.; Bujnovskij, A.S.; Sofronov, V.L.; Nukhachev, A.P. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. HAFNIUM FLUORIDES/purification; ZIRCONIUM FLUORIDES/purification; CHEMISORPTION; PURIFICATION; IMPURITIES; OPTICAL FIBERS; SUBLIMATION

**34689** (INIS-SU–276, pp. 12) **Noble metal fluorides.** Zemskov, S.V.; Mit'kin, V.N.; Shipachev, V.A.; Levchenko, L.M. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RUTHENIUM COMPLEXES/chemical reactions; CHEMICAL PREPARATION; FLUORIDES; SOLUTIONS; STABILITY

**34690** (INIS-SU–276, pp. 15) **Fluoride and chloride metallurgy of refractory metals. Comparison, achievements, prospects.** Nisel'son, L.A.; Elyutin, A.V. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. TRANSITION ELEMENT COMPOUNDS/extractive metallurgy; BOILING POINTS; CHEMICAL PREPARATION; CHLORIDES; FLUORIDES; IMPURITIES; MELTING POINTS; PURIFICATION; VAPOR PRESSURE

**34691** (INIS-SU–276, pp. 16) **Inorganic fluorides with high electron affinity.** Korobov, M.V.; Sidorov, L.N. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RUTHENIUM FLUORIDES/affinity; VANADIUM FLUORIDES/affinity; ELECTRONS; AFFINITY; STABILITY; VALENCE

**34692** (INIS-SU–276, pp. 23) **Applied aspects of niobium and tantalum fluoride chemistry.** Agulyanskij, A.I. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii.

1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NIOBIUM FLUORIDES/extractive metallurgy; TANTALUM FLUORIDES/extractive metallurgy; AQUEOUS SOLUTIONS; CHEMICAL PREPARATION; MOLTEN SALTS; NIOBIUM COMPLEXES; OXYFLUORIDES; PURIFICATION; TANTALUM COMPLEXES; USES

**34693** (INIS-SU–276, pp. 24) **High temperature treatment of fluoride niobium-and tantalum-containing solutions.** Agulyanskij, A.I.; Balabanov, Yu.I.; Gutsol, A.F.; Sokolova, M.I.; Voronina, V.S.; Zyrichev, N.A.; Merkushkin, V.I.; Ovchinnikov, V.A. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NIOBIUM FLUORIDES/hydrolysis; NIOBIUM FLUORIDES/pyrolysis; NIOBIUM OXIDES/chemical preparation; TANTALUM FLUORIDES/hydrolysis; TANTALUM FLUORIDES/pyrolysis; TANTALUM OXIDES/chemical preparation; AQUEOUS SOLUTIONS; CHEMICAL REACTION KINETICS; COLD PLASMA; EXTRACTIVE METALLURGY; HYDROLYSIS; PYROLYSIS

**34694** (INIS-SU–276, pp. 25) **On the problem of fluorine impurity in rare metal oxide powders obtained by plasmochemical method.** Agulyanskij, A.I.; Gutsol, A.F.; Korobejnikov, L.S.; Mel'nikova, V.M.; Pochivalov, S.S. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NIOBIUM OXIDES/purification; TANTALUM OXIDES/purification; CHEMICAL PREPARATION; CHEMICAL STATE; COLD PLASMA; FLUORIDES; IMPURITIES; PURIFICATION; POWDERS

**34695** (INIS-SU–276, pp. 28) **New noncentresymmetric compounds $M_5Nb_3OF_{18}$ (M=$NH_4$, K, Rb).** Agulyanskij, A.I.; Zavodnik, V.E.; Stefanovich, S.Yu.; Kuznetsov, V.Ya.; Sidorov, N.V.; Kalinnikov, V.T. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NIOBIUM COMPLEXES/tetragonal lattices; ALKALI METAL COMPOUNDS; AMMONIUM COMPOUNDS; CRYSTAL-PHASE TRANSFORMATIONS; FLUORIDES; LATTICE PARAMETERS; MONOCRYSTALS; OXYFLUORIDES

**34696** (INIS-SU–276, pp. 29) **Thermal decomposition of $(NH_4)_3NbOF_6$.** Agulyanskij, A.I.; Pochivalov, S.S.; Mel'nikova, V.M. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NIOBIUM COMPLEXES/pyrolysis; AMMONIUM COMPOUNDS; CHEMICAL REACTION KINETICS; HIGH TEMPERATURE; PYROLYSIS; OXYFLUORIDES; PYROLYSIS PRODUCTS

**34697** (INIS-SU–276, pp. 35) **On some properties of potassium heptafluorotantalate ($K_2TaF_7$).** Alenchikova, I.F.; Popov, A.I.; Sadikova, A.T.; Sukhoverkhov, V.F.; Takanova, N.D.; Shcherbilin, V.B. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. TANTALUM FLUORIDES/phase studies; TANTALUM FLUORIDES/thermal gravimetric analysis; IMPURITIES; LATTICE PARAMETERS; POTASSIUM FLUORIDES; PURIFICATION

**34698** (INIS-SU–276, pp. 36) **Stability of fluoride niobium (5) complexes in halide melts.** Alimova, Z.A.; Kremenetskij, V.G.; Polyakova, L.P.; Polyakov, E.G.; Stangrit, P.T. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NIOBIUM COMPLEXES/reduction; ACTIVATION ENERGY; ALKALI METAL COMPOUNDS; CHEMICAL REACTION KINETICS; CHLORIDES; FLUORIDES; MOLTEN SALTS; REDUCTION; STABILITY; VALENCE; VERY HIGH TEMPERATURE

**34699** (INIS-SU–276, pp. 37) **Thermodynamics of lower fluorides of niobium and tantalum $NbF_{2.5}$, $NbF_4$, $TaF_3$.** Alikhanyan, A.S.; Malkerova, I.P.; Butskij, V.D.; Pervov, V.S. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NIOBIUM FLUORIDES/dissociation heat; NIOBIUM FLUORIDES/formation heat; TANTALUM FLUORIDES/dissociation heat; TANTALUM FLUORIDES/formation heat; DIMERS; EXPERIMENTAL DATA; MASS SPECTROSCOPY; SUBLIMATION; VALENCE

**34700** (INIS-SU–276, pp. 40) **Phase equilibria in condensed system rhenium hexafluoride-hydrogen fluoride.** Andreev, G.G.; Zherin, I.I.; Amelina, G.N. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RHENIUM FLUORIDES/phase diagrams; BINARY MIXTURES; EQUILIBRIUM; EUTECTICS; HYDROFLUORIC ACID; LOW TEMPERATURE; MEDIUM TEMPERATURE; PHASE STUDIES; STRATIFICATION

**34701** (INIS-SU–276, pp. 41) **Liquid-solid equilibrium in the system iodine pentafluoride-bromine trifluoride.** Andreev, G.G.; Zherin, I.I.; Karpov, A.Yu.; Amelina, G.N.; Chukhin, I.A. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. IODINE FLUORIDES/phase diagrams; BINARY MIXTURES; BROMINE FLUORIDES; EQUILIBRIUM; EUTECTICS; FUSION HEAT; PHASE STUDIES

**34702** (INIS-SU–276, pp. 56) **Synthesis of complex fluorides showing promise as materials for ionizing radiation detectors on the basis of cross-luminescence phenomenon.** Baldova, M.V. (and others); Valbis, Ya.A.; Morozov, V.G. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ALKALI METAL COMPOUNDS/chemical preparation; BERYLLIUM FLUORIDES/chemical preparation; RARE EARTH COMPOUNDS/chemical preparation; YTTRIUM FLUORIDES/chemical preparation; COMPLEXES; LUMINESCENCE; SOLID SCINTILLATION DETECTORS

**34703** (INIS-SU–276, pp. 58) **Electric conductivity of solid electrolytes on the basis of $LaF_3$.** Bezmel'nitsyn, V.N.; Begichev, I.S. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. LANTHANUM FLUORIDES/solid electrolytes; SOLID ELECTROLYTES/electric conductivity; STRONTIUM FLUORIDES/solid electrolytes; BARIUM FLUORIDES; DENSITY; EXPERIMENTAL DATA; MEDIUM TEMPERATURE; MEDIUM VACUUM; SOLID SOLUTIONS

**34704** (INIS-SU–276, pp. 61) **Synthesis and growth of optical crystals $Ne_{0.4}(Ln,Y)_{0.6}F_{2.2}$.** Berkman, E.M.; Zamoryanskaya, M.V.; Koryakina, L.F.; Morozova, L.G.; Petrova, M.A.; Podkolzina, I.G.; Semenova, T.S. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPOUNDS/chemical preparation; YTTRIUM FLUORIDES/chemical preparation; CRYSTAL GROWTH; CZOCHRALSKI METHOD; MONOCRYSTALS; OPTICAL PROPERTIES; SODIUM FLUORIDES

**34705** (INIS-SU–276, pp. 66) **Dissociation enthalpies of complex molecules $MPbF_3$ (M=K, Rb, Cs).** Boltalin, A.I.; Rykov, A.N.; Korenev, Yu.M. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. CESIUM FLUORIDES/dissociation heat; EXPERIMENTAL DATA; FREE ENTHALPY; HIGH TEMPERATURE; LEAD FLUORIDES; MASS SPECTROSCOPY

**34706** (INIS-SU–276, pp. 68) **Investigation of tungsten hexafluoride purification by adsorption.** Borisenko, T.N.; Andreev, P.E.; Shajdurov, V.S. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. TUNGSTEN FLUORIDES/purification; CHEMICAL REACTION YIELD; CHEMISORPTION; DESORPTION; IMPURITIES; LOW PRESSURE; MEDIUM TEMPERATURE; SODIUM FLUORIDES; PURIFICATION

**34707** (INIS-SU–276, pp. 74) **Investigation of fluorination process of rare earth oxides by elemental fluorine.** Bujnovskij, A.S.; Volichko, N.S.; Karelin, A.I.; Kobzar', Yu.F.; Korablev, A.M.; Lodovskikh, A.K.; Portnyagina, Eh.A.; Serdyuk, V.N.; Sofronov, V.L. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RARE EARTH COMPOUNDS/fluorination; CHEMICAL REACTION KINETICS; CHEMICAL REACTION YIELD; CHEMICAL REACTORS; FLUORINE; HIGH TEMPERATURE; OXIDES; FLUORINATION

**34708** (INIS-SU–276, pp. 75) **On reprocessing of hafnium tetrafluoride sublimation residues by fluoride method.** Bujnovskij, A.S.; Karelin, A.I.; Korablev, A.M.; Lodovskikh, A.K.; Sofronov, V.L.; Sherstneva, L.A.; Korovin, Yu.F.; Mukhachev, A.P.; Aldakimov, V.A. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. HAFNIUM FLUORIDES/purification; HAFNIUM FLUORIDES/waste processing; CHEMICAL REACTION KINETICS; CHEMICAL REACTION YIELD; FLUORINATION; FLUORINE; PURIFICATION; HIGH TEMPERATURE; IMPURITIES; RESIDUES; SUBLIMATION; VACUUM EVAPORATION

**34709** (INIS-SU–276, pp. 77) **Investigation of the processes of zircon concentrate fluorination with elemental fluorine and silicon tetrafluoride trapping by sodium carbonate.** Bujnovskij, A.S.; Serdyuk, V.N.; Sofronov, V.L.; Kobzar', Yu.F.; Ledovskij, A.K.; Popov, L.I. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ZIRCON/fluorination; ACTIVATION ENERGY; CHEMICAL REACTION KINETICS; CHEMICAL REACTION YIELD; CHEMISORPTION; FLUORINE; HIGH TEMPERATURE; SILICON FLUORIDES; SODIUM CARBONATES; ZIRCON; FLUORINATION

**34710** (INIS-SU–276, pp. 78) **Volume desublimation of zirconium tetrafluoride.** Bujnovskij, A.S.; Sofronov, V.L.; Sherstneva, L.A. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ZIRCONIUM FLUORIDES/purification; FLOW RATE; IMPURITIES; KINETICS; PARTICLE SIZE; SUBLIMATION; VERY HIGH TEMPERATURE; PURIFICATION

**34711** (INIS-SU–276, pp. 86) **Kinetics of reduction of praseodymium and neodymium fluorides mixtures with calcium.** Varilov, M.M.; Sokolov, I.P.; Kosynkin, V.D.; Bystrov, A.N.; Bykov, A.D. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic

fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NEODYMIUM FLUORIDES/reduction; PRASEODYMIUM FLUORIDES/reduction; CALCIUM; CHEMICAL REACTION KINETICS; HIGH TEMPERATURE; IRON FLUORIDES; MIXTURES; REDUCTION; THERMAL GRAVIMETRIC ANALYSIS

**34712** (INIS-SU–276, pp. 87) **Investigation of the reaction between sodium xenon difluoride.** Vershinin, S.L.; Kiselev, N.I.; Churbanov, M.F. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. XENON FLUORIDES/chemical reaction kinetics; HIGH TEMPERATURE; LOW PRESSURE; MEDIUM TEMPERATURE; SODIUM

**34713** (INIS-SU–276, pp. 88) **Preparation and analysis of high-purity xenon difluoride.** Vershinin, S.L.; Churbanov, M.F.; Pimenov, V.G.; Kiselev, N.I. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. XENON FLUORIDES/purification; XENON FLUORIDES/quantitative chemical analysis; EMISSION SPECTROSCOPY; IMPURITIES; SENSITIVITY; SUBLIMATION; PURIFICATION

**34714** (INIS-SU–276, pp. 89) **Use of ionic conductors on the basis of lanthanum fluoride for developing chemical sensors.** Vecher, R.A.; Volodkovich, L.M. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. LANTHANUM FLUORIDES/ionic conductivity; LANTHANUM NITRIDES/ionic conductivity; LANTHANUM SULFIDES/ionic conductivity; ACTIVATION ENERGY; OXYFLUORIDES

**34715** (INIS-SU–276, pp. 96) **Synthesis and certain physico-chemical properties of lanthanum and yttrium dichlorofluorides.** Vozhdaeva, E.E.; Eliseeva, S.S. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. LANTHANUM COMPOUNDS/chemical preparation; YTTRIUM COMPOUNDS/chemical preparation; CHEMICAL PROPERTIES; DENSITY; HALIDES; HIGH TEMPERATURE; MELTING POINTS

**34716** (INIS-SU–276, pp. 101) **Crystal preparation and study of dielectric properties of inorganic fluorides $AF_2$ (A=Ba, Sr, Pb, Cd).** Voronov, V.N.; Krasikov, V.S. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM FLUORIDES/crystal growth; STRONTIUM FLUORIDES/crystal growth; BRIDGMAN METHOD; DIELECTRIC PROPERTIES; MONOCRYSTALS

**34717** (INIS-SU–276, pp. 104) **Synthesis and physicochemical properties of acid potassium hexafluorohafnate.** Glagolevskaya, A.L.; Kuznetsova, S.V.; Stogova, T.V.; Kuznetsov, V.Ya.; Mikhajlova, N.L.; Kuznetsov, S.A. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. HAFNIUM COMPLEXES/chemical preparation; CRYSTAL-PHASE TRANSFORMATIONS; DENSITY; FLUORIDES; HYDROGEN COMPOUNDS; LATTICE PARAMETERS; MELTING POINTS; ORTHORHOMBIC LATTICES; POTASSIUM COMPOUNDS; PYROLYSIS; REFRACTIVITY; SPACE GROUPS

**34718** (INIS-SU–276, pp. 106) **Preparation of fluoride products from the Kola titanium-and zirconium-containing raw materials.** Godneva, M.M.; Motov, D.L.; Okhrimenko, R.F. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ZIRCONIUM FLUORIDES/chemical preparation; BADDELEYITE; CHEMICAL REACTION YIELD; ORE PROCESSING; ZIRCONIUM ORES

**34719** (INIS-SU–276, pp. 107) **Study of formation amd properties of complexex in the system $ZrO_2$-$H_2SO_4$-$NH_4F$-$H_2O$.** Godneva, M.M.; Motov, D.L.; Okhrimenko, R.F.; Nikitina, S.D.; Rys'kina, M.P. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ZIRCONIUM COMPLEXES/chemical preparation; ZIRCONIUM OXIDES/phase diagrams; AMMONIUM FLUORIDES; AQUEOUS SOLUTIONS; CHEMICAL COMPOSITION; CRYSTAL LATTICES; PHASE STUDIES; REFRACTIVITY; SULFURIC ACID

**34720** (INIS-SU–276, pp. 111) **Certain properties of tetrafluoroboric acid of industrial value.** Gofman, Eh.E.; Chernyj, I.S.; Ermakova, L.I.; Korobitsin, A.S.; Kandakov, V.P. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BORON COMPLEXES/chemical preparation; AQUEOUS SOLUTIONS; DENSITY; ELECTRIC CONDUCTIVITY; FLUORIDES; MEDIUM TEMPERATURE; QUANTITY RATIO; TEMPERATURE DEPENDENCE

**34721** (INIS-SU–276, pp. 113) **Investigation of the LiF-$BaF_2$-$YbF_3$ system.** Gracheva, I.Yu.; Sidorov, V.S. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul

1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. YTTERBIUM FLUORIDES/phase diagrams; BARIUM FLUORIDES; CHEMICAL REACTIONS; EUTECTICS; FUSION HEAT; HIGH TEMPERATURE; LITHIUM FLUORIDES; MELTING POINTS; VERY HIGH TEMPERATURE

**34722** (INIS-SU–276, pp. 115) **Kinetics of lithium tantalate dissolution in hydrofluoric and sulfuric acid mixture.** Gubochkin, B.A.; Melkumyants, M.V.; Rakov, Eh.G. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. TANTALATES/dissolution; BINARY MIXTURES; CHEMICAL REACTION KINETICS; ETCHING; HYDROFLUORIC ACID; LITHIUM COMPOUNDS; MEDIUM TEMPERATURE; PLATES; QUANTITY RATIO; SULFURIC ACID; TANTALATES; DISSOLUTION

**34723** (INIS-SU–276, pp. 122) **Synthesis and study of ternary compounds $C_xF$-$HalF_n$-HF ($HalF_n$=$BrF_3$, $BrF_5$, $IF_5$).** Danilenko, A.M.; Yakovlev, I.I. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CLATHRATES/chemical preparation; IODINE FLUORIDES/clathrates; CLATHRATES; CRYSTAL LATTICES; GRAPHITE; HYDROFLUORIC ACID; PYROLYSIS

**34724** (INIS-SU–276, pp. 124) **Reaction between gaseous iodine heptafluoride and elementary bromine.** Dzikovskij, B.G.; Drobyshevskij, Yu.V. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. IODINE FLUORIDES/chemical reaction kinetics; ACTIVATION ENERGY; BROMINE; HIGH TEMPERATURE; LOW PRESSURE; MEDIUM TEMPERATURE; VAPORS

**34725** (INIS-SU–276, pp. 125) **Synthesis of iodine heptafluoride.** Drobyshevskij, Yu.V.; Utrobin, D.V. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. IODINE FLUORIDES/chemical preparation; CHEMICAL REACTION YIELD; HIGH TEMPERATURE; LOW PRESSURE; MEDIUM TEMPERATURE; QUANTITY RATIO

**34726** (INIS-SU–276, pp. 126) **Reaction of sodium in carbon with fluorine-containing compounds.** Dronov, G.A.; Shnitko, G.N.; Chistova, T.P.; Terent'ev, Yu.V. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BORON FLUORIDES/chemical reactions; CARBON; CLATHRATES; HIGH TEMPERATURE; SODIUM

**34727** (INIS-SU–276, pp. 127) **Synthesis of graphite interaction compounds of general formula $C_nMF$ and $(CF_x)_nMF$.** Dronov, G.A.; Shnitko, G.N.; Chistova, T.P.; Terent'ev, Yu.V. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CESIUM FLUORIDES/clathrates; CLATHRATES/chemical preparation; CLATHRATES; CHEMICAL REACTION YIELD; GRAPHITE; HIGH TEMPERATURE

**34728** (IS-T–1412) **Reduced molybdenum oxidation states in hydrodesulfurization catalysis by Chevrel phases.** Ekman, M.E. Ames Lab., IA (United States). Jul 1991. 216p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE91018168. Source: OSTI; NTIS; GPO Dep.

The catalytic activities of reduced (relative to $Mo^{4+}$) molybdenum sulfides, known as Chevrel phases, have been evaluated for thiophene and benzothiophene hydrosulfurization (HDS) and 1-butene hydrogenation (HYD). These materials have been found to have HDS activities comparable to, or greater than, model unpromoted and cobalt-promoted $MoS_2$ catalysts; in contrast, Chevrel phases exhibit low activities for 1-butene HYD. X-ray powder diffraction and laser Raman spectroscopy analysis of the used (10 hours of thiophene reaction) catalysts indicated that the bulk structures were stable under reaction conditions. XPS analysis demonstrated that reduced molybdenum oxidation states were present at the surface, compared to the $Mo^{4+}$ state of the $MoS_2$ catalysts. The effect of the oxidation state of molybdenum on the catalytic HDS of thiophene was investigated using a series of lead-lutetium Chevrel phases with compositions of $Lu_{1.2x}PbMo_6S_8$ for $0 \leq x \leq 0.2$, and $Lu_{1.2x}Pb_{1-x}Mo_6S_8$ for $0.2 < x \leq 1$. These same materials were used to evaluate the chemisorption of $O_2$ and NO as probe molecules of catalytically active sites. 179 refs., 20 figs., 8 tabs.

**34729** (IS-T–1567) **Dimetization kinetics and products of $\alpha$-substituted o-quinodimethanes derivd from benzene and furan.** Leung, Man-kit. Ames Lab., IA (United States). Sep 1991. 256p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE91018555. Source: OSTI; NTIS; GPO Dep.

a-Substituent effects on the dimerization of furan-based and benzene-based o-quinodimethanes (o-QDM's) are reported. The mechanistic implications of these results are discussed. 3-Ethylidene-2-methylene-, 2-ethylidene-3-methylene-, and 2,3-diethylidene-2,3-dihydrofuran were prepared by fluoride induced 1,4-conjugative elimination of trimethylsilyl acetate from the appropriate precursors. The $^1H$ NMR spectra of these furan-based o-quinodimethanes were obtained and the dimerization products of each were studied. It was found that a methyl group at the 3-methylene position retards the rate of of dimerization which is consistent with the previously proposed dimerization mechanism, the two-step diradical mechanism. The preparation of a-methyl-, a-cyclopropyl-, a-tert-butyl-, and a-mesityl-o-oxylylene and the kinetics and product analyses of their Diels-Alder reactions and dimerization are reported. Trapping the reactive o-QDM's with methyl methacrylate gives more of the "ortho" than the "meta" isomers in all cases we studied. The change from a-methyl- to a-cyclopropyl to a-tert-butyl-o-xylylene results in a decrease of the "ortho" to "meta" ratio from 8.8 to 4.3 to 2.2, respectively. The trend of the regioselectivity is consistent with the concerted mechanism. 35 refs., 92 figs., 65 tabs.

**34730** (LA-UR–91-2882) **Thermal generation and mobility of charge carriers in collective proton transport in hydrogen-bonded chains.** Peyrard, M. (Dijon Univ., 21 (France). Faculte des Sciences); Boesch, R.; Kourakis, I. Los Alamos National Lab., NM (United States). [1991]. 15p. Sponsored by USDOE, Washington,

DC (United States). DOE Contract W-7405-ENG-36. (CONF-9105115–1: North Atlantic Treaty Organization (NATO) ARW workshop on computation of transport properties in the dilute gas region, Porto Carras (Greece), 28-31 May 1991). Order Number DE92000306. Source: OSTI; NTIS; INIS; GPO Dep.

The transport of protons in hydrogen-bonded systems is a long standing problem which has not yet obtained a satisfactorily theoretical description. Although this problem was examined first for ice, it is relevant in many systems and in particular in biology for the transport along proteins or for proton conductance across membranes, an essential process in cell life. The broad relevance makes the study of proton conduction very appealing. Since the original work of Bernal and Fowler on ice, the idea that the transport occurs through chains of hydrogen bonds has been well accepted. Such "proton wires" were invoked by Nagle and Morowitz for proton transport across membranes proteins and more recently across lipid bilayers. In this report, we assume the existence of such an hydrogen-bonded chain and discuss its consequences on the dynamics of the charge carriers. We show that this assumption leads naturally to the idea of soliton transport and we put a special emphasis on the role of the coupling between the protons and heavy ions motions. The model is presented. We show how the coupling affects strongly the dynamics of the charge carriers and we discuss the role it plays in the thermal generation of carriers. The work presented has been performed in 1986 and 87 with St. Pnevmatikos and N. Flyzanis and was then completed in collaboration with D. Hochstrasser and H. Buettner. Therefore the results presented in this part are not new but we think that they are appropriate in the context of this multidisciplinary workshop because they provide a rather complete example of the soliton picture for proton conduction. This paper discusses the thermal generation of the charge carriers when the coupling between the protons and heavy ions dynamics is taken into account. The results presented in this part are very recent and will deserve further analysis but they already show that the coupling can assist for the formation of the charge carriers.

**34731** (ORNL/tr–91/6) **Determination of diffusion coefficients in liquids using the diaphragm cell method.** Schoen, N. (Karlsruhe Univ. (T.H.) (Germany). Inst. fuer Thermische Verfahrenstechnik). Oak Ridge National Lab., TN (United States); Karlsruhe Univ. (T.H.) (Germany). Inst. fuer Thermische Verfahrenstechnik. [1991]. 128p. Translation of German thesis submitted December 17, 1986, 131 p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91018403. Source: OSTI; NTIS; GPO Dep.

Diffusion coefficients in liquids are usually very highly dependent on concentration. In general it is not possible either to predict the boundary diffusion coefficients (diffusion coefficients with great dilution of one component) or to describe the concentration dependence of the diffusion coefficients in the mixture. Therefore they must be determined experimentally. A suitable method for this purpose is measurement using a Stokes diaphragm cell. The basic idea of this method consists in placing the entire diffusion resistance in a diaphragm, which separates two liquid mixtures of different concentration from one another. In the present study the binary diffusion coefficients of the isopropanol-glycerol and water-glycerol systems in the concentration range of 0–100 mol% glycerol shall be measured at two temperatures between 20°C and 50°C. The test results shall be compared with the semi-empirical equations known from the literature. 47 refs., 46 figs., 14 tabs.

**34732** (UCRL-ID–107877) **Estimation of uranyl acetate volatilities in the molten salt processor under pyrolytic operating conditions.** Krikorian, O.H. Lawrence Livermore National Lab., CA (United States). 8 Aug 1991. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018659. Source: OSTI; NTIS; GPO Dep.

This study is part of a general task to evaluate the volatilities of Pu and U during treatment of mixed wastes in a molten salt processor operating under either oxidizing or pyrolysing conditions. Here, we assess the volatility of U as gaseous uranyl acetate, by calculating the uranyl acetate vapor pressure under pyrolysis conditions that use a 2:1 molar ratio of $CO_2$ to $O_2$ to burn dodecane in the processor operating at temperatures of 400–1000 K. The volatility of uranyl acetate is found to be exceedingly low under these conditions, i.e., less than $10^{-20}$ atm. 15 refs., 7 tabs.

## 4004 Electrochemistry

*Refer also to citation(s) 33578, 33767, 33791, 34224, 34611, 35259*

## 4005 Photochemistry

*Refer also to citation(s) 33855*

**34733** (BNL–52265, pp. 242) **Photoinduced electron-transfer induced bond-cleavage reactions of substituted amines.** Ci, X. (Univ. of Rochester, NY (USA)); Kellett, M.; Haugen, C.; Bergmark, W.; Whitten, D. Brookhaven National Lab., Upton, NY (United States). [1989]. (CONF-8906383–Summ.: 14. DOE solar photochemistry research conference, Lake Harmony, PA (United States), 3-7 Jun 1989). In *Proceedings of the Fourteenth DOE solar photochemistry research conference*. 271p. Order Number DE91006617. Source: OSTI; NTIS.

It was found that organic amines containing suitable substitution on the $\beta$-carbon can undergo novel photofragmentation reactions, leading to high chemical yields of 2-electron redox products. In the present paper, three different aspects of the overall reaction will be reported. (1) Aminoketone C-C Bond Cleavage Reactions. Aminoketones undergo selective cleavage via photoinduced SET activation of appropriate electron acceptors giving rise to a number of different products, depending upon acceptor and solvent, arising from initial attack of reduced acceptor ($A\cdot^-$) on oxidized donor. Permanent products arising from subsequent dark reactions include the corresponding amides and the carbonyl product $R_2R_3CO$. (2) Photosensitized Oxidations of Aminoketones. A special case of the above reaction involves singlet oxygen as the excited acceptor. In this case attack of $O_2\cdot^-$ on oxidized donor leads to cleavage at the acyl carbon and formation of a peracid derivative. (3) Intramolecular Photosensitized SET Cleavage of Aminoalcohols. Aminoalcohols containing a tethered light-absorbing acceptor have recently been synthesized and their photophysics and photoreactivity are under investigation. These compounds are rapidly decomposed on photolysis with light absorbed only by the acceptor. One such compound exhibits intramolecular exciplex fluorescence and a moderate efficiency for photolysis to generate benzaldehyde as the chief product isolated thus far. Two other such compounds are even more photolabile and rapid reaction during purification during purification procedures has posed a problem in characterizing their overall reactivity.

**34734** (DOE/ER/14039–2) **Photchemistry of intermolecular C-H bond activation reactions: Progress report.** Lees, A.J. State Univ. of New York, Binghamton, NY (United States). 22 Aug 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14039. Order Number DE91018967. Source: OSTI; NTIS; GPO Dep.

We have focused mainly on the solution photochemistry of the $CpRh(CO)_2$ and $Cp^*Rh(CO)_2$ ($Cp = \eta^5\text{-}C_5H_5$; $Cp^* = \eta^5\text{-}C_5Me_5$) systems. Previously, we had found that the photosubstitutional chemistry of $CpRh(CO)_2$ apparently proceeds via an associative process; this was an unexpected finding and it brought into question the assignment of a 16-electron CpRh(CO) intermediate (formed by initial CO dissociation) in these photochemical substitution and C-H bond activation reactions. In other related studies, we have been exploring the photochemical transformations taking place in a series of high nuclearity osmium cluster complexes. 7 refs., 1 fig., 1 tab.

**34735** **Photocatalytic decomposition of organic compounds in aqueous solutions.** Magrini, K.A.; Webb, J.D. Solar Energy Research Inst., Golden, CO (United States). [1991]vp. Source: Solar Energy Research Institute, Golden, CO.

The degradation of aqueous trichloroethylene (TCE) to $Co_2$ and HCl is accomplished photocatalytically by irradiating TCE solutions, which contain suspensions of anatase $TiO_2$, with simulated sunlight. Increases in the incident beam energy increase the TCE decomposition rate. Destruction of TCE was demonstrated from initial concentrations of 60 ppM to less than 50 ppB.

**34736 Photocatalytic decomposition of aqueous trichloroethylene and direct red-79 with $TiO_2$ as a function of irradiation indensity.** Magrini, K.A.; Webb. J.D. Solar Energy Research Inst., Golden, CO (United States). [1991]vp. Source: Solar Energy Research Institute, Golden, CO.

The degradation of aqueous trichloroethylene (TCE) to $CO_2$ and HCl is accomplished photocatalytically by irradiated TCE solutions, which contain suspensions of anatase $TiO_2$, which simulated sunlight.

## 4006 Radiation Chemistry

*Refer also to citation(s) 33822, 33823, 33826*

**34737** (INIS-SU–266, pp. 98-99) **Diffuse reflection electron spectroscopy study of radiolysis of alumonickelmolybdenum oxide systems in accelerated electron beam.** Adigamov, B.Ya. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Lunin, V.V.; Miroshnichenko, I.I.; Solovetskij, Yu.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 fig. ALUMINIUM OXIDES/radiolysis; MOLYBDENUM OXIDES/radiolysis; NICKEL OXIDES/radiolysis; ABSORPTION SPECTRA; RADIOLYSIS; ELECTRON BEAMS; HEAT TREATMENTS; MEV RANGE 01-10; PHASE STUDIES; SULFIDES; VERY HIGH TEMPERATURE

**34738** (INIS-SU–266, pp. 103) **Radiolysis of water adsorbed on specimens of commercial-grade silica gel.** Buka, E.V. (Tomskij Politekhnicheskij Inst., Tomsk (USSR)); Ketskalo, V.M.; Serikov, L.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. WATER/radiolysis; ADSORPTION; G VALUE; HYDROGEN; RADIATION DOSES; RADICALS; SILICA GEL; WATER; RADIOLYSIS

**34739** (INIS-SU–266, pp. 105) **Processes of cadmium ion radiolytic precipitation in cadmium-containing solutions of electrolytic production.** Gabisoniya, L.V. (AN Gruzinskoj SSR, Tbilisi (USSR). Inst. Neorganicheskoj Khimii i Ehlektrokhimii); Tushurashvili, R.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CADMIUM SULFIDES/chemical radiation effects; CHEMICAL EFFLUENTS/waste processing; AQUEOUS SOLUTIONS; CHEMICAL REACTION YIELD; ELECTROMETALLURGY; GAMMA RADIATION; PRECIPITATION

**34740** (INIS-SU–266, pp. 108-109) **Radiation induced copolymerization of 2-methyl-5-vinyltetrazole with N-alkylamines.** Govorkov, A.T.; Sirik, E.V.; Boyarkina, N.M.; Dolgopolov, N.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. VINYL MONOMERS/chemical radiation effects; AMINES; AQUEOUS SOLUTIONS; CHEMICAL REACTION YIELD; COPOLYMERIZATION; DOSE RATES; GAMMA RADIATION; ORGANIC SOLVENTS; QUANTITY RATIO; RADIATION DOSES; TETRAZOLES

**34741** (INIS-SU–266, pp. 111) **Radiation induced destruction of nitrocellulose in heterogeneous and homogeneous media.** Govorkov, A.T.; Bannova, E.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. NITROCELLULOSE/radiolysis; G VALUE; NITROCELLULOSE; RADIOLYSIS; ORGANIC SOLVENTS; RADIATION DOSES; SLURRIES; SOLUTIONS

**34742** (INIS-SU–266, pp. 112-113) **Radiation induced polymerization of 2-methyl-5-vinyltetrazole in homogeneous and heterogeneous media.** Govorkov, A.T.; Muryshkina, E.V.; Bannova, E.A.; Khokhlova, G.P. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref., 1 fig. VINYL MONOMERS/chemical radiation effects; CHEMICAL REACTION YIELD; DOSE RATES; GAMMA RADIATION; MOLECULAR WEIGHT; ORGANIC SOLVENTS; POLYMERIZATION; RADIATION DOSES; SOLUTIONS; TETRAZOLES

**34743** (INIS-SU–266, pp. 114-115) **Prediction of radiation properties of polymers using increment method.** Govorkov, A.T.; Stalkovskij, V.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. POLYMERS/density; POLYMERS/radiation effects; COMPUTER CODES; COMPUTERIZED SIMULATION; FORECASTING; POLYMERS; DENSITY; RADIATION DOSES

**34744** (INIS-SU–266, pp. 116-117) **Effect of γ-radiation on the structure of nitrocellulose.** Govorkov, A.T.; Dolgopolov, N.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2:*

*Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 3 figs. NITROCELLULOSE/radiolysis; DOSE RATES; GAMMA RADIATION; MOLECULAR STRUCTURE; NITROCELLULOSE; RADIOLYSIS; RADIATION DOSES; X-RAY DIFFRACTION

**34745** (INIS-SU–266, pp. 119) **Radiation-thermal processes in heterogeneous system brown coal-pentadecane.** Gulieva, N.K. (AN Azerbajdzhanskoj SSR, Baku (USSR). Sektor Radiatsionnykh Issledovanij); Mustafaev, I.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ALKANES/radiolysis; LIGNITE/radiolysis; ALKANES; RADIOLYSIS; BINARY MIXTURES; COAL GASIFICATION; DOSE RATES; ELECTRON BEAMS; GAMMA RADIATION; HIGH TEMPERATURE; LIGNITE; RADIATION DOSES; TEMPERATURE DEPENDENCE

**34746** (INIS-SU–266, pp. 120) **Material balance of radiation-adsorption removal of chlorophos on AG-3 charcoal in the flow.** Danilin, D.I. (AN SSSR, Moscow (USSR). Inst. Ehlektrokhimii); Shubin, V.N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. PHOSPHONIC ACID ESTERS/radiolysis; ACTIVATED CARBON; ADSORPTION; AQUEOUS SOLUTIONS; GAMMA RADIATION; INSECTICIDES; LIQUID FLOW; MATERIAL BALANCE; ORGANIC CHLORINE COMPOUNDS; RADIOLYSIS

**34747** (INIS-SU–266, pp. 121) **Equilibrium dynamics of radiosorption purification of soluble chemical contaminants. Peculiarities of the process proceeding in non-linear region of convex sorption isotherm.** Dyagilev, S.A. (AN SSSR, Moscow (USSR). Inst. Ehlektrokhimii); Shubin, V.N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CHEMICAL EFFLUENTS/chemical radiation effects; ADSORPTION; ADSORPTION ISOTHERMS; LIQUID FLOW; PURIFICATION; WASTE WATER

**34748** (INIS-SU–266, pp. 124-125) **Purification of aluminium oxide catalysts in the process of radiation-heat treatment.** D'yakov, V.P.; Miroshnichenko, I.I.; Ryabchenko, P.V.; Solovetskij, Yu.I.; Fesenko, O.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 2 refs., 1 fig. ALUMINIUM OXIDES/chemical radiation effects; ALUMINIUM OXIDES/purification; PURIFICATION; CARBON COMPOUNDS; CATALYSTS; DESORPTION; ELECTRON BEAMS; HEAT TREATMENTS; HIGH TEMPERATURE; IMPURITIES; KINETICS; MEV RANGE 01-10; SULFUR COMPOUNDS

**34749** (INIS-SU–266, pp. 127-128) **Effect of the radiolysis of NaA and NaY zeolites on the adsorption properties.** Ermatov, S.E. (Kazakhskij Pedagogicheskij Inst., Alma-Ata (USSR)); Mosienko, T.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref., 3 figs. ZEOLITES/radiolysis; ACTIVATION ENERGY; ADSORPTION ISOTHERMS; DESORPTION; GAMMA RADIATION; OXYGEN; PILE NEUTRONS; RADIATION DOSES; ZEOLITES; RADIOLYSIS

**34750** (INIS-SU–266, pp. 136) **Study of oxidation processes in aqueous solutions of thiourea and thioacetamide.** Ignatashvili, S.G. (AN Gruzinskoj SSR, Tbilisi (USSR). Inst. Neorganicheskoj Khimii i Ehlektrokhimii); Natsvilishvili, S.E.; Svenidze, E.O. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. AMIDES/chemical radiation effects; THIOUREA/chemical radiation effects; AMIDES; AQUEOUS SOLUTIONS; GAMMA RADIATION; OXIDATION; OZONE; THIOUREA

**34751** (INIS-SU–266, pp. 137) **Preparation of high purity metals by radiolysis of inorganic azides.** Krylov, V.V.; Sidorin, Yu.Yu.; Kirilova, I.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. AZIDES/chemical radiation effects; AZIDES; IMPURITIES; IONIZING RADIATIONS; PURIFICATION; RADIATION DOSES; SILVER; SILVER COMPOUNDS

**34752** (INIS-SU–266, pp. 143) **Radiation-thermal transformations in heterogeneous system brown coal-methane.** Makhmudov, O.M. (AN Azerbajdzhanskoj SSR, Baku (USSR). Sektor Radiatsionnykh Issledovanij); Kerimov, M.A.; Mustafaev, I.I.; Ermakov, A.N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. LIGNITE/radiolysis; METHANE/radiolysis; BINARY MIXTURES; COAL GASIFICATION; COAL LIQUEFACTION; DOSE RATES; ELECTRON BEAMS; GAS FLOW; HIGH TEMPERATURE; LIGNITE; RADIOLYSIS; METHANE; RADIATION DOSES

**34753** (INIS-SU–266, pp. 145-146) **Feasibility study of radiation-chemical processing of waster water from Khimprom production association.** Miklin, M.B.; Kriger, L.D.; Kondratova, G.A.; Khisamov, B.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CHEMICAL EFFLUENTS/radiolysis; CHEMICAL EFFLUENTS/waste processing; ACTIVATED CARBON; ADSORPTION; RADIOLYSIS; GAMMA RADIATION; LIQUID WASTES; ORGANIC COMPOUNDS; PURIFICATION; RADIATION DOSES; X RADIATION

**34754** (INIS-SU–266, pp. 156) **Application of radiation-heterogeneous processes to improve the efficiency of sewage treatment.** Najdanov, O.D. (AN SSSR, Ulan-Ude (USSR). Inst. Estestvennykh Nauk); Ryazantsev, A.A.; Khakhinov, V.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. SODIUM SULFIDES/chemical radiation effects; WASTE WATER/chemical radiation effects; WASTE WATER/waste processing; AERATION; AQUEOUS SOLUTIONS; CATALYSTS; EFFICIENCY; INDUSTRIAL WASTES; OXIDATION; PH VALUE; RADIATION DOSES

**34755** (INIS-SU–266, pp. 159-160) **Joint action of ionizing radiation and radiolytic ozone on acetone aqueous solutions.** Podzorova, E.A.; Kasperovich, A.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ACETONE/chemical radiation effects; WASTE WATER/chemical radiation effects; WASTE WATER/waste processing; ACETONE; AERATION; AQUEOUS SOLUTIONS; CHEMICAL EFFLUENTS; ELECTRON BEAMS; IONIZING RADIATIONS; OXIDATION; OZONE

**34756** (INIS-SU–266, pp. 164-165) **Investigation of endothermic catalytic reactions in the radiation field of electron accelerator.** Tanashev, Yu.Yu. (AN SSSR, Novosibirsk (USSR). Inst. Kataliza); Prokop'ev, S.I.; Aristov, Yu.I.; Parmon, V.N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. AMMONIA/radiolysis; METHANE/radiolysis; METHANOL/radiolysis; AMMONIA; RADIOLYSIS; CATALYSIS; DOSE RATES; EFFICIENCY; ELECTRON BEAMS; ENERGY CONVERSION; G VALUE; HYDROGEN; METHANE; METHANOL; MEV RANGE 01-10; RADIATION DOSES

**34757** (INIS-SU–266, pp. 166) **Radiation-chemical transformations in heterogeneous systems containing elementary phosphorus.** Tarasova, N.P. (Moskovskij Khimiko-Tekhnologicheskij Inst., Moscow (USSR)); Mikhajlova, E.G.; Smetannikov, Yu.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. PHOSPHORUS/chemical radiation effects; AQUEOUS SOLUTIONS; CHEMICAL REACTION KINETICS; G VALUE; PHOSPHORUS

**34758** (INIS-SU–266, pp. 169) **Preparation of manganese dioxide from manganese salt solutions in the field of radiation.** Tushureshvili, R.G. (AN Gruzinskoj SSR, Tbilisi (USSR). Inst. Neorganicheskoj Khimii i Ehlektrokhimii); Gabisoniya, L.V.; Ivanitskaya, L.V.; Chikvaidze, N.M. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MANGANESE SULFATES/chemical radiation effects; AQUEOUS SOLUTIONS; CHEMICAL PREPARATION; CHEMICAL REACTION YIELD; ELECTRON BEAMS; G VALUE; GAMMA RADIATION; MANGANESE OXIDES; MEDIUM TEMPERATURE; OXIDATION; OXIDIZERS; RADIATION DOSES

**34759** (INIS-SU–266, pp. 170) **Radiation effects in composite materials on polymer mixture base.** Tujchiev, Sh.T. (Tadzhikskij Gosudarstvennyj Univ., Dushanbe (USSR)); Ginzburg, B.M.; Kuznetsova, A.M.; Nuraliev, D.S.; Mukhammadieva, A.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. POLYMERS/radiation effects; POLYMERS/thermal expansion; COBALT 60; COMPOSITE MATERIALS; DOSE-RESPONSE RELATIONSHIPS; FILMS; POLYMERS

**34760** (INIS-SU–266, pp. 174) **Copper recovery from waste water of electrolytic metallurgy by radiation-chemical method.** Chikvaidze, N.M. (AN Gruzinskoj SSR, Tbilisi (USSR). Inst. Neorganicheskoj Khimii i Ehlektrokhimii); Tushurashvili, R.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. COPPER SULFATES/chemical radiation effects; WASTE WATER/chemical radiation effects; WASTE WATER/waste processing; CHEMICAL EFFLUENTS; CHEMICAL REACTION

YIELD; DOSE RATES; ELECTROLYSIS; G VALUE; GAMMA RADIATION; HYPOPHOSPHOROUS ACID; RADIATION DOSES; REDUCTION

**34761** (JAERI-M–91-054) **Annual report of the Osaka Laboratory for Radiation Chemistry Japan Atomic Energy Research Institute, 22. April 1, 1988 - March 31, 1989.** Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1991. 51p. Order Number DE92704085. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes research activities of Osaka Laboratory for Radiation Chemistry, JAERI during one year period from April 1, 1988 through March 31, 1989. The latest report, for 1987, is JAERI-M 90-054. Detailed descriptions of the activities are presented in the following subjects : (i) studies on laser-induced organic chemical reactions and (ii) studies on radiation chemistry of high polymers and radiation dosimetry. (J.P.N.).

**34762** (KURRI-TR–346) **Radiation induced structural changes.** Ogasawara, Masaaki (Hokkaido Univ., Sapporo (Japan). Faculty of Engineering); Matsuyama, Tomochika (eds.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Mar 1991. 66p. (In Japanese). Order Number DE92704351. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation chemistry has been considered as plain reaction chemistry, but recently the situation has changed. It has become to be utilized actively at the forefront of material science, such as the control of crystal growth, the synthesis of thin films and ultrafine particles, the reforming and making functional of substances and so on. It is due to the increase of the kinds of available radiation and the development of precision control technology. This workshop was planned on the basis of such critical mind that what structural change is induced in substances by radiation. The structural change in the title includes physical change in addition to the ordinary structural change in radiation chemistry. The relaxation and subsequent chemical change and physical change of the initial products by radiation in substances were discussed as the process of a series of structural change. Also in this workshop, the problems in the boundary region between radiation chemistry and photochemistry were discussed as these two research fields came close rapidly by the multiple photon absorption of laser and the utilization of synchrotron radiation. In this report, the gists of eight lectures are collected. (K.I.).

## 4007 Radiochemistry and Nuclear Chemistry

*Refer also to citation(s) 33731, 33821, 34495, 34627, 34631*

**34763** (BNL–46589) **Criteria for the selection of radionuclides for tumor radioimmunotherapy.** Srivastava, S.C.; Mausner, L.F.; Mease, R.C. Brookhaven National Lab., Upton, NY (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9109287–1: 4. international symposium on the synthesis and applications of isotopes and isotopically labeled compounds, Toronto (Canada), 3 Sep 1991). Order Number DE92000485. Source: OSTI; NTIS; INIS; GPO Dep.

The potential of utilizing monoclonal antibodies as carriers of radionuclides for the selective destruction of tumors (radioimmunotherapy, RIT) has stimulated much research activity. From dosimetric and other considerations, the choice of radiolabel is an important factor that needs to be optimized for maximum effectiveness of RIT. This paper reviews and assesses a number of present and future radionuclides that are particularly suitable for RIT based on the various physical, chemical, and biological considerations. Intermediate to high-energy beta emitters' (with and without gamma photons in their emission) are emphasized since they possess a number of advantages over alpha and Auger emitters. Factors relating to the production and availability of candidate radiometals as well as their stable chemical attachment to monoclonal antibodies are discussed. 34 refs., 4 tabs.

**34764** (CIEMAT–673) **General Tritium labelling of gentamicin C by catalytic hydrogen exchange reaction with tritiated water.** Suarez, C.; Diaz, D. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1991. 27p. (In Spanish). Order Number DE92700012. Source: OSTI; NTIS (US Sales Only).

Gentamicin C was labelled with tritium by means of a $PtO_2$ catalyzed hydrogen exchange reaction. Under the conditions of the exchange (100 mg of gentamicin, basic form, 0,3 ml $H_2O$-$^3H$, and 50 mg of prereduced $PtO_2$) the radiochemical yield was 0,24, 0,38 and 0,48 % at 120C, for 8, 16 and 24 hours respectively. Chemical yield for purified gentamicin was about 60 %. Purification was accomplished with a cellulose column eluted with the lower phase of chloroform-methanol 17 % ammonium hydroxide (2:1:1, v/v). Chemical purity, determined by HPLC, was 96,5 % and radiochemical one was 95 % . Main exchange degradation products show biological activity. (Author)

**34765** (INIS-SU–253/A, pp. 426) **Features of structural chemistry of 3d metal (Eu(3) and $[UO_2]^{2+}$) complexes.** Toshev, M.T.; Dustov, Kh.B.; Parpiev, N.A.; Yusupov, V.G.; Karimov, M. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. EUROPIUM COMPLEXES/molecular structure; URANYL COMPLEXES/molecular structure; CHELATES; CHEMICAL COMPOSITION; COORDINATION NUMBER; CRYSTAL STRUCTURE; HYDRATES; ISOMERIZATION; KETONES; LIGANDS; ORGANIC NITROGEN COMPOUNDS; ORGANIC SULFUR COMPOUNDS

**34766** (INIS-SU–253/A, pp. 467) **New thorium and uranium complexes containing two and three ligands-porphyrins: structure and reactivity.** Lomova, T.N.; Andrianova, L.G.; Berezin, B.D. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. THORIUM COMPLEXES/molecular structure; THORIUM COMPLEXES/solubility; URANIUM COMPLEXES/molecular structure; URANIUM COMPLEXES/solubility; ABSORPTION SPECTRA; COORDINATION VALENCES; ELECTRON SPECTRA; MIXED SOLVENTS; PORPHYRINS; STABILITY; SOLUBILITY

**34767** (INIS-SU–253/A, pp. 473) **Vibrational and luminescence spectra of uranyl derivatives of diacid acids with donor ligands.** Chumaevskij, N.A.; Sharopov, O.U.; Minaeva, N.A. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 ref. URANYL COMPLEXES/molecular structure; CARBOXYLIC ACID SALTS; CHEMICAL COMPOSITION; LIGANDS; LUMINESCENCE; SPECTRA; VIBRATIONAL STATES

**34768** (INIS-SU–253/A, pp. 486) **Trivalent uranium complexing with crown ethers.** Kulyukhin, S.A. (AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii); Kamenskaya, A.N.; Mikheev, N.B. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj

Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. URANIUM COMPLEXES/chemical preparation; URANIUM COMPLEXES/solubility; CHEMICAL COMPOSITION; HETEROCYCLIC COMPOUNDS; IODIDES; POLYETHYLENE GLYCOLS; SENSITIVITY; THERMAL DEGRADATION; SOLUBILITY

**34769** (INIS-SU–253/A, pp. 492) **Effect of nature of electroneutral ligands on composition and structure of $UO_2XO_4$center dotnL complexes.** Blatov, V.A. (Kujbyshevskij Gosudarstvennyj Univ., Kuibyshev (USSR)); Serezhkina, L.B.; Serezhkin, V.N. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. 1 tab. URANYL COMPLEXES/crystal structure; URANYL COMPLEXES/molecular structure; AMIDES; CARBONIC ACID DERIVATIVES; CHEMICAL COMPOSITION; CHROMATES; MONOCRYSTALS; SELENATES; SULFATES

**34770** (INIS-SU–253/A, pp. 523) **Some data on hydroxide compounds of pentavalent neptunium and americium.** Tananaev, I.G. AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; AN Belorusskoj SSR, Minsk (Byelorussian SSR); Belorusskij Gosudarstvennyj Univ., Minsk (Byelorussian SSR). 1990. 212p. (In Russian). (CONF-9005347–: 17. all-union Chugaev conference on complex compound chemistry, Minsk (USSR), 29-31 May 1990). In *17. All-union Chugaev conference on complex compound chemistry. Pt. 3: Summaries of reports.* Order Number DE92001307. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. AMERICIUM COMPLEXES/chemical preparation; NEPTUNIUM COMPLEXES/chemical preparation; ALKALI METAL COMPOUNDS; COORDINATION VALENCES; HYDRATES; HYDROXIDES; SOLUBILITY

**34771** (INIS-SU–276, pp. 53) **Study of $O_2F$-radical interaction with uranium tetrafluoride and uranyl fluoride.** Bagryantsev, V.V.; Timakov, A.A.; Prusakov, V.N. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. URANIUM TETRAFLUORIDE/fluorination; URANYL FLUORIDES/fluorination; CHEMICAL REACTION KINETICS; FLUORINE OXIDES; RADICALS; FLUORINATION

**34772** (INIS-SU–276, pp. 63) **Investigation of uranyl selenate complexes with fluorides of some alkali metals and ammonium.** Blatov, V.A.; Serezhkina, L.B.; Serezhkin, V.N. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ALKALI METAL COMPOUNDS/crystal lattices; URANIUM COMPLEXES/crystal lattices; AMMONIUM COMPOUNDS; FLUORIDES; HYDRATES; LATTICE PARAMETERS; MONOCRYSTALS; SELENATES; SPACE GROUPS

**34773** (INIS-SU–276, pp. 128) **Investigation of phase equilibria in the systems uranium hexafluoride - fluorocarbons.** Evdokimov, A.N.; Sladkov, L.Yu.; Seredenko, V.A.; Filippov, E.A.; Fomina, N.G. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. URANIUM HEXAFLUORIDE/phase diagrams; DENSITY; EUTECTICS; FREONS; MELTING POINTS; QUANTITY RATIO; SOLUTIONS

**34774** (LBL–31134) **The 40th AAAS Gordon Conference on nuclear chemistry.** Seaborg, G.T. Lawrence Berkeley Lab., CA (United States). 27 Jun 1991. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9106282–1: 40. American Association for the Advancement of Science (AAAS) Gordon conference on nuclear chemistry, New London, NH (United States), 27 Jun 1991). Order Number DE92000844. Source: OSTI; NTIS; INIS; GPO Dep.

I am pleased to speak at the Fortieth Gordon Conference on Nuclear Chemistry. I served as Chairman of the first Gordon Conference on Nuclear Chemistry held June 23–27, 1952, at New Hampton, New Hampshire. In my remarks, during which I shall quote from my journal, I shall describe some of the background leading up to the first Gordon Conference on Nuclear Chemistry and my attendance at the first seven Gordon Conferences during the period 1952 through 1958. I shall also quote my description of my appearance as the featured speaker at the Silver Anniversary of the Gordon Research Conferences on December 27, 1956 held at the Commodore Hotel in New York City. I shall begin with reference to my participation in the predecessor to the Gordon Conferences, the Gibson Island Research Conferences 45 years ago, on Thursday, June 20, 1946, as a speaker. This was 15 years after the start of these conferences in 1931. Neil Gordon played a leading role in these conferences, which were named (in 1948) in his honor – the Gordon Research Conferences – soon after they were moved to Colby Junior College, New London, New Hampshire in 1947. W. George Parks became Director in 1947, Alexander Cruickshank became Assistant Director in 1947 and Director in 1968.

**34775** (ORNL/TM–11881) **Nuclear Medicine Program progress report for quarter ending June 30, 1991.** Knapp, F.F. Jr.; Ambrose, K.R.; Callahan, A.P.; McPherson, D.W.; Mirzadeh, S.; Srivastava, P.C.; Hasan, A.; Lambert, C.R.; Lambert, S.J.; Rice, D.E. Oak Ridge National Lab., TN (United States). Sep 1991. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000383. Source: OSTI; NTIS; GPO Dep.

In this report the excitation functions for production of gallium-66 via $\alpha$-induced nuclear reactions on enriched zinc-66 have been measured with $E_\alpha \leq 27.3$ Mev and $E_\alpha \leq 43.7$ MeV employing the stack thin-target technique. In addition, the induced activity of gallium-67 in the same sets of targets allowed an evaluation of the excitation functions of the corresponding nuclear reactions. These preliminary studies have demonstrated that sufficient levels of gallium-66 can be produced by $\alpha$-induced reactions on enriched zinc targets. A series of radioiodinated analogues of 1-azabicyclo[2.2.2]oct-3-yl $\alpha$-hydroxy-$\alpha$, $\alpha$-diphenylacetate (QNB) have been prepared. These new analogues include 1-azabicyclo-[2.2.2]oct-3-yl$\alpha$-hydroxy-$\alpha$-(4-iodophenyl)-$\alpha$-methylacetate(2,I-WNA), 1-azabicyclo[2.2.2]oct-3-yl (3-iodo)-xanthene-9-carboxylate (3,I-QNX), and 1-azabicyclo[2.2.2]oct-3-yl $\alpha$-hydroxy-$\alpha$-(E-1-iodo-1-propen-3-yl)-$\alpha$-phenylacetate (4,I-QNP), which have also been radiolabeled with

iodine-125 with high specific activity. The biodistribution, brain uptake, and receptor specificity of these new analogues are currently being studied. Shipments of radioactive agents made to collaborators during this period included. One shipment of iodine-125-labeled 15-(p-iodophenyl)-3-R,S-methylpentadecanoic acid (BMIPP) and tungsten-188/rhenium-188 generator. 16 refs., 7 figs., 1 tab.

## 4008 Combustion, Pyrolysis, and High-Temperature Chemistry

*Refer also to citation(s) 33589, 33738, 33771, 33845*

**34776** (KTM/E-B--83) **LIEKKI Combustion technology: Interim report 1988-1990.** Hupa, M. (Aabo Akademi, Turku (Finland)). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1991. 87p. Project KTM-60/881/87. Order Number DE92704047. Source: OSTI; NTIS (US Sales Only).

Finland's energy research programmes. Published also in Finnish Report no B:82.

The LIEKKI combustion research program is divided into five research areas: Modeling of combustion processes, Combustion chemistry, Diagnostics and analytical methods, Pressurized combustion and Applied projects. The first three of these research areas represent theoretical research as well as experimental laboratory work carried out at universities or various public research centers. This research aims at a better understanding of the combustion process and associated phenomena without commitment to any particular combustion technology - the results will thus be more widely applicable to current or future combustion techniques. These studies address such problems as the numerical modeling of furnaces, chemistry of sulfur and nitrogen compounds, combustion behavior of fuels under varying burning conditions, temperature measurement of burning particles, further development of analysis methods of emissions from combustion processes, etc. A central objective of the program is to develop and to create suitable conditions for a new generation of power plant concepts that will allow the efficiency of electricity production to be advanced significantly from the present level, while controlling the associated environmental hazards. Technologies identified during the program as showing promise in this respect include combined-cycle processes based on pressurized fluidized bed combustion or gasification and a gas turbine. The fourth research area is concentrated on studies associated with pressurized fluidized bed combustion, using two pilot test rigs. The fifth research area includes a number of research and development projects of a more directly applied nature: these are proprietary development projects of the companies participating in the program. Most of these projects are concerned with the reduction of harmful emissions from existing plants by improved combustion techniques.

# 42 ENGINEERING

## 4202 Facilities, Equipment, and Techniques

*Refer also to citation(s) 33730, 34002, 34218, 34243, 34498, 34515, 34571, 34829, 34833, 35421*

**34777** (CEA-CONF--10509) **Overview of P.I.E. techniques for L.W.R. fuels at Saclay hot cells with special emphasis on new apparatus and on mechanical testing.** Blanc, J.Y.; Hardy, J.L.; Trotabas, M. CEA Centre d'Etudes de Saclay, 91 - Gif-sur-Yvette (France). Direction des Reacteurs Nucleaires. 1990. 12p. (CONF-9009423--: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). Order Number DE92703744. Source: OSTI; NTIS (US Sales Only).

This paper describes the state-of-the-art in the Saclay hot cells for examining L.W.R. fuels. First, we present the classical path followed by a fuel rod in the laboratory, to begin with non-destructive testing. This is completed by destructive examinations, such as free volume determination and fission gases analyses, density measurement and metallographies including X-rays diffraction and microprobe (EPMA/WDX). These two last techniques enable the identification of elements and chemical nature of compounds which are present. We also perform mechanical tests on metallic components, on clads and guide-tubes (tensile tests, creep, burst or fatigue tests by internal pressure). Another apparatus is devoted to the study of irradiated clad behaviour during LOCA-type transients. In the second chapter, a particular emphasis is given to the developments in progress, or planned in the near future. This includes: (a) The implementation of a new non-destructive testing bench to inspect more fuel rods simultaneously. (b) A new image analyzer to be applied e.g. to hydrides analysis in the clad, or to the inspection of safety test fuel bundles. (c) As for mechanical testing, we describe here the tensile tests on clads or on guide-tubes, performed on longitudinal samples or ring samples.

**34778** (CONF-8906112--, pp. 33-40) **Approximate methods for dynamic plastic deformation of structures.** Youngdahl, C.K. (Argonne National Lab., IL (USA)). Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

To illustrate the development of approximation methods and correlation parameters for dynamic plasticity, the problem of a long tube loaded by a spatially-varying pressure pulse applied over a time-dependent region is considered for a rigid, perfectly plastic material. The final plastic deformation is found to depend on an effective applied force, an effective applied moment, an effective length of the loaded region, and the deformation that would be attained if the loading were applied impulsively. A procedure is developed for approximating the results by closed-form solutions for loadings applied to fixed regions. The implications of the solutions with respect to other approximation methods and extension of the method to include strain hardening effects are discussed.

**34779** (CONF-9109121--3) **Decision support system development using a migration approach.** MacGregor, D.G. (MacGregor-Bates, Inc., Eugene, OR (United States)); Tonn, B.; Goeltz, R. Oak Ridge National Lab., TN (United States). Sep 1991. 15p. Sponsored by Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC05-84OR21400. From Symposium on expert system applications for the electric power industry; Boston, MA (United States); 9-11 Sep 1991. Order Number DE91018860. Source: OSTI; NTIS; GPO Dep.

Virtually all organizations in the utility industry rely on some form of computerized decision support to assist in the management of operations and maintenance. As decision support needs evolve, new technologies are introduced and old technologies are updated, when possible and cost effective. Unfortunately, new designs are often superior to old ones, and retrofitting does not prove feasible, resulting in many pieces of "stand-alone" equipment that are not integrated into a common decision support framework. This paper develops a model for integrating decision support systems of diverse vintage into a common workstation, using a migration approach. The model is applied in the design and development of an integrated workstation to support operations and maintenance of a microwave communication system for power system monitoring and control. The system, called CAP for Computerized Alarm Processing, provides an integration of decision support functions previously performed manually, integrates dispersed databases, and provides both expert system and statistical analysis capabilities. The fielded system is currently in operation at the Bonneville Power Authority's Dittmer Control Center. The implications of the migration approach for upgrading power system decision support are discussed. 6 refs., 6 figs.

**34780** (CONF-911213--2) **Long-reach manipulation for waste storage tank remediation.** Jansen, J.F.; Burks, B.L.; Babcock, S.M.; Kress, R.L.; Hamel, W.R. Oak Ridge National Lab., TN (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) annual winter meeting; Atlanta, GA (United States); 1-6 Dec 1991. Order Number DE91013234. Source: OSTI; NTIS; INIS; GPO Dep.

Remediation of large underground storage tanks containing hazardous waste provides an application for state-of-the-art technology

in flexible link manipulator design and control and a need for additional research and development. Application requirements are described, and preliminary analyses associated with this problem are summarized. Inherent physical limitations of flexible manipulators are discussed. Potential kinematic configurations, drive-train elements, and control issues for both free-space motion and damping of forced vibration are addressed. Also included are future directions for research and development in mechanical components and control strategies. 21 refs., 4 figs., 4 tabs.

**34781** (DOE/NE/37967–T5) **DOE/NE robotics for advanced reactors: Bimonthly progress report, June–July 1991.** Florida Univ., Gainesville, FL (United States). Dept. of Nuclear Engineering Sciences. [1991]. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86NE37967 ;FG02-86NE37968 ;FG02-86NE37969 ;FG02-86NE37966 ;AC05-84OR21400. Order Number DE91018835. Source: OSTI; NTIS; GPO Dep.

This document details activities during this reporting period. ORNL is continuing to transfer technology under the NE Robotics for Advanced Reactors Program to other programs and institutions. The HELIX and MICA computer architecture developed under the NE robotics program have been installed at the University of Florida departments of Nuclear and Mechanical Engineering of ORNL researchers. HELIX has also been installed at ORNL in the Engineering Division for use in mechanical design. Preliminary discussions with Public Service Electric and Gas (PSE&G) have indicated a strong possibility of signing a Cooperative Research and Development Agreement (CRADA) with ORNL. The joint project will involve utilizing robotic technology developed under the Robotics for Advanced Reactors Program to develop and test a maintenance robot at ORNL and PSE&G. The University of Texas team has completed initial operation of the actuator module. The Tennessee group has completed a milestone in developing multi- primitive hierarchical stereo techniques and resulting in the award of a Ph.D. degree. The Michigan group has concentrated its efforts on methods for improving the performance of ultrasonic range sensors. The Florida team continues to model key features of the Hot Fuel Examination Facility (HFEF) in Idaho. Remote manipulator arms in the facility are being modeled using the IGRIP modeling system.

**34782** (DOE/OR/00033–T449) **Nuclear engineering enrollments and degrees, 1990: Appendixes.** Oak Ridge Associated Universities, Inc., TN (United States). Jul 1991. 58p. Sponsored by USDOE, Washington, DC (United States); Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE91018189. Source: OSTI; NTIS; GPO Dep.

These appendices provide data on nuclear degree trends by institution, enrollment, degree, region, state, and socio-economic factors. (FI)

**34783** (EGG-WTD–9765) **Robotics subsurface mapping demonstration technology test plan.** Griebenow, B.E. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jun 1991. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018786. Source: OSTI; NTIS; INIS; GPO Dep.

The Subsurface Disposal Area (SDA) at the Radioactive Waste Management Complex (RWMC) contains an estimated 2 million cubic feet of contaminated, hazardous, radioactive buried waste. The waste was received in cardboard boxes, steel drums plywood boxes, and as loose material. Possible leaching of the buried waste may have created mixed hazardous fill dirt, with an estimated volume of 6 million cubic feet. The Department of Energy has committed to clean up the SDA. Cleanup efforts will include characterizing and removing the waste. Waste characterization provides information on what, where, and how much waste is buried. This information will be used to determine how the waste will be removed and treated. Limited historical data of the waste buried within the SDA exist, but have not been verified and are believed to be incorrect or incomplete in many cases. There are two objectives to the Robotics Subsurface Mapping Demonstration. The first is to demonstrate the feasibility of using a remotely operated platform to perform characterization operations. In the demonstration, the Soldier Robot Interface Project (SRIP) platform will be equipped with multiple sensors to provide data for buried waste characterization and will be remotely controlled and tracked by the Ultrasonic Ranging and Data System (USRADS). The second objective of the demonstration is to characterize the waste in locations within the SDA, as specified by the Buried Waste Integrated Demonstration (BWID) Project.

**34784** (EUR–13345) **Large packages for reactor decommissioning waste.** Price, M.S.T. (UKAEA Atomic Energy Establishment, Winfrith (UK). Materials Technology). Commission of the European Communities, Luxembourg (Luxembourg). 1991. 140p. Contract No FI1D-0045. Source: OSTI; NTIS (US Sales Only).

This study was carried out jointly by the Atomic Energy Establishment at Winfrith (now called the Winfrith Technology Centre), Windscale Laboratory and Ove Arup and Partners. The work involved the investigation of the design of large transport containers for intermediate level reactor decommissioning waste, ie waste which requires shielding, and is aimed at European requirements (ie for both LWR and gas cooled reactors). It proposes a design methodology for such containers covering the whole lifetime of a waste disposal package. The design methodology presented takes account of various relevant constraints. Both large self shielded and returnable shielded concepts were developed. The work was generic, rather than specific; the results obtained, and the lessons learned, remain to be applied in practice.

**34785** (IWGFPT–37, pp. 19-24) **Hot cell facility of the European Institute for Transuranium Elements: Non-destructive and destructive examinations of individual rods.** Coquerelle, M. (Commission of the European Communities. Karlsruhe (Germany, F.R.). European Inst. for Transuranium Elements). International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

The $\alpha$, $\gamma$-Hot Cell Facility of the European Institute for Transuranium Elements with 24 concrete and lead hot cells is one of the largest inert atmosphere facilities of this type in Europe. Since it went into operation in December 1966, this laboratory has been used for destructive, non-destructive examinations and radiochemical analyses of irradiated mixed oxide, carbide and nitride fuels. Reorientation of the research programme towards the fields of reactor safety and waste management has required this Hot Cell Facility for the analysis of ramped $UO_2$ fuels, highly active glasses, high burn-up $UO_2$ MOX fuels as waste forms and mixed Am,Np oxides. The 24 $\alpha$, $\gamma$ lead and concrete hot cells are capable of handling activities from $10^4$ up to $10^6$ Curie at 1 Mev. The capacity of the radiometallurgy and radiochemistry laboratories are described. 5 refs, 5 figs, 1 tab.

**34786** (IWGFPT–37, pp. 25-44) **Hot cell facility: Non-destructive examinations for light water reactor fuel rods.** Velde, J. van de (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)); Gys, A.; Mies, L. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

The Laboratory for High and Medium level Activity LHMA, situated in the Nuclear Centre SCK/CEN Mol - Belgium, offers a complete set of post-irradiation examinations for the power reactor fuel. Since the start of the examinations on commercial fuel in our installations, considerable effort has been undertaken in the field of the non-destructive inspection on LWR fuel rods guiding destructive examinations. Special emphasis has been put on improvements of

test procedures in order to provide reliable information concerning the actual state of the fuel rod. A description of the multipurpose hot cell for non-destructive inspections is given as well as some specific items related to test procedures. (author). 4 refs, 15 figs, 2 tabs.

**34787** (IWGFPT–37, pp. 45-49) **Overview of PIE techniques for LWR fuels at Saclay hot cells with special emphasis on new apparatus and on mechanical testing.** Blanc, J.Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Hardy, J.L.; Trotabas, M. International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the state-of-the-art in the Saclay hot cells for examining L.W.R. fuels. First, we present the classical path followed by a fuel rod in the laboratory, to begin with non-destructive testing: visual, metrological, eddy current (on the clad and on the zirconia layer) and $\gamma$-scan inspections. This is completed by destructive examinations, such as free volume determination and fission gases analyses, density measurement and metallographies including X-rays diffraction and microprobe (EPMA/WDX). These two last techniques enable the identification of elements and chemical nature of compounds which are present. Some complementary examinations are performed in other C.E.A. laboratories, such as S.E.M., burn-up (Nd) and mass spectrometry. We also perform mechanical tests on metallic components. on clads and guide-tubes (tensile tests, creep, burst or fatigue tests by internal pressure). Another apparatus is devoted to the study of irradiated clad behaviour during LOCA-type transients. Finally, some other expertise can be done on the assembly itself (temperatures, metrology), on grid springs (tensile tests on very tiny samples), and on upper plates (visual, spring rigidity). In the second chapter, a particular emphasis is given to the developments in progress, or planned in the near future. This includes: (a) The implementation of a new non-destructive testing bench to inspect more fuel rods simultaneously. (b) A new image analyzer to be applied e.g. to hydrides analysis in the clad, or to the inspection of safety test fuel bundles (blockage ratio, percentages of each component, ...). (c) As for mechanical testing, we describe here the tensile tests on clads or on guide-tubes, performed on longitudinal samples or ring samples (made by spark machining). These are particularly convenient for comparing low and very high burn-up fuels, where clads are becoming increasingly brittle. (author). 6 refs, 7 figs.

**34788** (IWGFPT–37, pp. 107-110) **Application of mercurometric analysis methods to radioactive (and/or toxic) samples: Pycnometry and porosimetry.** Sannen, L. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). International Atomic Energy Agency, Vienna (Austria). International Working Group on Water Reactor Fuel Performance and Technology. May 1991. (CONF-9009423–: Technical committee meeting on post-irradiation examination techniques for water reactor fuel, Workington (United Kingdom), 11-14 Sep 1990). In *Post-irradiation examination techniques for water reactor fuel: Proceedings of a technical committee meeting held in Workington, Cumbria, United Kingdom, 11-14 September 1990.* 164p. Order Number DE92601446. Source: OSTI; NTIS (US Sales Only); INIS.

The analytical tools and methods used in the laboratory of High and Medium Activity of the Nuclear Research Centre in Mol to determine the density and the open porosity of radioactive (and/or toxic) samples are described. The density is determined by a vacuum pycnometer with plunger displacement. This home-made apparatus has been automated up to a high degree so that operation is easily performed in the remote handling conditions of a hot cell environment. The amount of mercury displaced by the sample is measured. The accuracy is better than 0.2 %. The porosimeter is a commercial apparatus which was modified to improve the hot cell compatibility and to provide fast processing of the data. The open porosity and its pore size distribution are determined from the measurement of the amount of mercury intruded into the sample under increasing pressure. The paper describes both instruments and the working methods. Also included are some examples of measurement results. (author). 5 figs.

**34789** (JAERI-M–91-101) **A study on intelligent nuclear systems (HASP: Human Acts Simulation Program): Progress report 1990.** Asai, Kiyoshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Fujii, Minoru; Higuchi, Kenji; Kume, Etsuo; Ohtani, Takayuki; Far, B.H.; Kambayashi, Shaw; Akimoto, Masayuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 184p. (In Japanese). Order Number DE92704290. Source: OSTI; NTIS (US Sales Only); INIS.

The fourth year progress of the Human Acts Simulation Program HASP in short, has been presented in this report. The HASP started in 1987 at JAERI as a ten-year research and development program of underlying technologies for intelligent robots, intelligent nuclear plants and so on. It consists of the research and development of technologies of a knowledge-base system, robot vision, robot kinematics/kinetics, plant geometry database, dose evaluation and high speed Monte Carlo machine. (author).

**34790** (JAERI-M–91-105) **Design of $H_\infty$-filter to estimate a linear system state in the frequency domain.** Suzuki, Katsuo (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Shimazaki, Junya; Shinohara, Yoshikuni. Japan Atomic Energy Research Inst., Tokyo (Japan). Jul 1991. 48p. (In Japanese). Order Number DE92713917. Source: OSTI; NTIS (US Sales Only); INIS.

A design procedure of a state estimator is described which minimizes the $H_\infty$-norm of the estimation error power spectrum matrix. This achieves the optimal estimator in the frequency domain by finding the estimator transfer function matrix that leads to an equalizing filter. Numerical simulations are performed to demonstrate a clear advantage of the $H_\infty$-estimate over the conventional $l^2$-estimate. (author).

**34791** (LA-UR–91-2284) **Detection of structural degradation.** Endebrock, E.G. Los Alamos National Lab., NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-911241–1: 3. international machinery monitoring and diagnostic conference, Las Vegas, NV (United States), 9-12 Dec 1991). Order Number DE91016040. Source: OSTI; NTIS; GPO Dep.

A time domain method developed for determining dynamic system characteristics is applied to structural monitoring and/or flaw detection. The potential usefulness for monitoring is evaluated based on several criteria, which include sensitivity to structural changes, location of flaws, and dependence upon excitation signals. The strengths and weaknesses of the methods are discussed. Also, structural monitoring using a signal's singular values is presented and evaluated. 2 refs., 4 figs., 2 tabs.

**34792** (ORNL/M–1677) **BES Welding Science Contractors summary report, 1990–1991.** David, S.A. (comp.). Oak Ridge National Lab., TN (United States). [1991]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91018510. Source: OSTI; NTIS; GPO Dep.

This is a compilation of four short papers on the subject of welding. Researchers from Oak Ridge National Laboratory, Pennsylvania State University, Colorado School of Mines, and the University of Alabama contributed contributed to this coordinated research effort. Weld metal microstructure, crack propagation, mass transfer, surface tension, composite materials, grain boundaries, and the properties of various alloys are topics of discussion. (GHH)

**34793** (ORNL/tr–90/25) **Startup and testing of an experimental system for investigating coupled heat and mass transport in falling film absorption of water vapor into aqueous LBr solutions.** Riede, T. Oak Ridge National Lab., TN (United States). [1991]. 71p. Translation of German diploma thesis, August 1985. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91017787. Source: OSTI; NTIS; GPO Dep.

Absorption systems have two major applications: first, in refrigeration and air conditioning engineering, where the are used for absorption refrigeration machines and heat pumps, and secondly in the chemical industry, where they are used in particular for gas scrubbing. By absorption we mean the dissolution of gases in liquid (or in special cases even in solid) absorbing agents. Absorption on a falling film is characterized particularly by very good heat removal, which is made possible by the small thickness of the falling film. In addition, there is a defined surface, which facilities a prediction of mass transfer. However, when designing falling film absorbers one still encounters unsolved problems. This is due to the fact for this coupled heat and mass transfer problem there is still great uncertainty regarding determination of the heat and mass transfer coefficients and the hydrodynamics of the falling film is by no means explained by its wave formation. Using the experimental system completed in the course of the present research in conjunction with a diploma thesis, absorption of water vapor into an aqueous lithium bromide solution shall be analyzed with the goal of determining temperature and concentration curves over the running length that will make it possible to determine heat transfer and mass transfer coefficients and thus facilitate the efficient design of falling film absorbers.

**34794** (ORNL/tr–91-8) **Correction product for printing inks.** Krampe, S.E. (Minnesota Mining and Mfg. Co., St. Paul, MN (United States)); Pierce, J.N. Oak Ridge National Lab., TN (United States). [1991]. 23p. Translation of German Patent No. 2,840,220 A1. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91017722. Source: OSTI; NTIS; GPO Dep.

The invention pertains to the removal of printed ink characters from substrates. In particular, the invention pertains to correction products specifically for printing inks made of printed ink-specific correction product applied to a flexible substrate. These printing ink-specific correction products are used to lift off vertically cohesive printed ink symbols from the substrates where they have been placed. The present invention corrects certain difficulties inherent in the existing correction materials, by proposing a correction product that is extremely specific for printing inks. That is, the correction product has a clearly greater adhesion affinity for vertically cohesive printing ink than for the substrate, e.g. paper, onto which the printing ink is normally set. The invention pertains to a printing ink-specific correction product on a flexible substrate. This printing ink-specific correction product contains preferably one or more thermoplastic, synthetic polymer adhesion resins, a compatible softener resin and optionally a compatible, adhesion-modifying resin. Sixteen examples are included.

**34795** (POEF-T–3569) **Conceptual design for PSP mounting bracket.** Ransom, G.; Stein, R. Portsmouth Gaseous Diffusion Plant, OH (United States). 16 Aug 1991. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. (CONF-9110117–2: 2. international conference on uranium hexafluoride handling, Oak Ridge, TN (United States), 29-31 Oct 1991). Order Number DE91018901. Source: OSTI; NTIS; INIS; GPO Dep.

Protective structural packages (PSP's or overpacks) used to ship $2\frac{1}{2}$-ton UF product cylinders are bolted to truck trailers. All bolts penetrate two longitudinal rows of wooden planks. Removal and replacement is required at various intervals for maintenance and routine testing. A conceptual design is presented for mounting brackets which would securely attach PSP's to trailer frames, reduce removal and replacement time, and minimize risk of personnel injury. 1 ref., 2 figs.

**34796** (POEF-T–3574) **A nuclear criticality safety assessment of the loss of moderation control in $2\frac{1}{2}$ and 10-ton cylinders containing enriched $UF_6$.** Newvahner, R.L. (Portsmouth Gaseous Diffusion Plant, OH (United States)); Pryor, W.A. Portsmouth Gaseous Diffusion Plant, OH (United States). 16 Aug 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00001. (CONF-9110117–6: 2. international conference on uranium hexafluoride handling, Oak Ridge, TN (United States), 29-31 Oct 1991). Order Number DE91018896. Source: OSTI; NTIS; INIS; GPO Dep.

Moderation control for maintaining nuclear criticality safety in 2-1/2-ton, 10-ton, and 14-ton cylinders containing enriched uranium hexafluoride ($UF_6$) has been used safely within the nuclear industry for over thirty years, and is dependent on cylinder integrity and containment. This assessment evaluates the loss of moderation control by the breaching of containment and entry of water into the cylinders. The first objective of this study was to estimate the required amounts of water entering these large $UF_6$ cylinders to react with, and to moderate the uranium compounds sufficiently to cause criticality. Hypothetical accident situations were modeled as a uranyl fluoride ($UO_2F_2$) slab above a $UF_6$ hemicylinder, and a $UO_2$ sphere centered within a $UF_6$ hemicylinder. These situations were investigated by computational analyses utilizing the KENO V.a Monte Carlo Computer Code. The results were used to estimate both the masses of water required for criticality, and the limiting masses of water that could be considered safe. The second objective of the assessment was to calculate the time available for emergency control actions before a criticality would occur, i.e., a "safetime," for various sources of water and different size openings in a breached cylinder. In the situations considered, except the case for a fire hose, the safetime appears adequate for emergency control actions. The assessment shows that current practices for handling moderation controlled cylinders of low enriched $UF_6$, along with the continuation of established personnel training programs, ensure nuclear criticality safety for routine and emergency operations. 2 refs., 5 figs., 1 tab.

**34797** (RFP–4459) **Holdup measurements of plutonium in glove box exhausts.** Glick, J.B. (EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant); Haas, F.X.; McKamy, J.N.; Garrett, A.G.; Russo, P.A.; Sheppard, G.A.; Miller, M.C. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. [1991]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-910901–6: 4. international conference on facility operations/safeguards interface, Albuquerque, NM (United States), 29 Sep - 4 oct 1991). Order Number DE91018556. Source: OSTI; NTIS; INIS; GPO Dep.

A new measurement technique has been developed to quantify plutonium in process glove box exhausts. The tecnnique implemented at Rocky Flats Plant utiltizes a shielded, collimated 0.5in. x 0.5in. bismuth germanate (BGO) gamma-ray detector. Pairs of measurements are made at one foot intervals along the duct. One measurement is made with the detector viewing the bottom of the duct with the detector crystal approximately 2 inches from the duct surface. The second measurement is made on the top of the exhaust pipe with the detector crystal 2 inches from the top of the duct. When the detector is placed in the bottom assay position, the area of the holdup material is assumed to extend beyond the detector field of view. The concentration of plutonium in $g/cm^2$ is obtained from this bottom measurement. The deposit width is determined from a model developed to relate the deposit width to the ratio of the count rates measured at the two positions, above and below the duct. Once a deposit width has been calculated, it is multiplied by the concentration determined from the bottom measurement to yield a mass- per-unit-length at the duct location. Total plutonium mass is then determined by multiplying the duct length by the average of the mass- per-unit length assays performed along the duct. The applicability of the technique is presented in a comparison of field measurement data to analysis results on material removed from the ducts. 3 refs., 3 figs., 1 tab.

**34798** (RFP-Trans–514) **Electrode assembly of tips and torches for arc welding with a nonconsumable electrode.** Rybakov, A.S. (Tul'skij Politekhnicheskij Inst., Tula (USSR)). EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. Aug 1990. 6p. Translation of USSR Patent No. 761183, September 7, 1980. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91017834. Source: OSTI; NTIS; GPO Dep.

This invention pertains to an electrode assembly for tips and torches used in arc welding with a nonconsumable electrode, which contains an electrode holder with installed rod electrodes that create a channel for supplying a shield gas, that is distinguished by the fact that, for the purpose of facilitating welding at increased speeds by improving the three-dimensional stability of

the arc, a channel is formed by three sharpened electrodes that form a common working face with diameter equal to 0.6 to 0.7 the diameter of a rod, and the grinding length of the rods is equal to 2 to 3 rod diameters. 3 refs., 3 figs.

**34799** (RFP-Trans–520) **Electrode for welding.** Dudko, D.A. (Electric-Welding Institute im. Ye. O. (USSR)); Ivanova, O.N.; Kornienko, A.N.; Steblovskii, B.A. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. Oct 1990. 2p. Translation of Russian Patent No. 266110, March 17, 1970. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91018515. Source: OSTI; NTIS; GPO Dep.

Short communication. GAS TUNGSTEN-ARC WELDING; ELECTRODES/design; INVENTIONS; CUTTING; ELECTRODES; DESIGN; RARE EARTHS; YTTRIUM OXIDES; LANTHANUM OXIDES; RODS

**34800** (SAND–91-0491C) **A chaotic system for the generation of extreme mechanical environments.** Paez, T.L.; Gregory, D.L.; Kelton, D.; Coleman, R. Sandia National Labs., Albuquerque, NM (United States). [1991]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911241–3: 3. international machinery monitoring and diagnostic conference, Las Vegas, NV (United States), 9-12 Dec 1991). Order Number DE91018358. Source: OSTI; NTIS; GPO Dep.

A proposed system and technique for generating high frequency, high amplitude vibration environments is presented. These environments are created using a device attached to a common vibration exciter that permits multiple metal on metal impacts driving a test surface. Previous analytical studies (Refs. 1 and 2) predicted that test environments with an energy content exceeding 10 kHx could be achieved using sinusoidal and random shaker excitations. The analysis predicted that chaotic vibrations yielding random-like test environments could be generated from sinusoidal inputs. In this study, a much simplified version of the proposed system was fabricated and tested in the laboratory. Experimental measurements demonstrate that even this simplified system, utilizing a single impacting object, can generate environments on the test surface with significant frequency content in excess of 80 kHz. A theoretical model of the system is described and the results are compared with the experimental results for the simplified system. 5 refs., 8 figs.

**34801** (SAND–91-1548) **Converting a commercial electric direct-drive robot to operate from joint torque commands.** Muir, P.F. Sandia National Labs., Albuquerque, NM (United States). Jul 1991. 38p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE92000611. Source: OSTI; NTIS; GPO Dep.

Many robot control algorithms for high performance in-contact operations including hybrid force/position, stiffness control and impedance control approaches require the command the joint torques. However, most commercially available robots do not provide joint torque command capabilities. The joint command at the user level is typically position or velocity and at the control developer level is voltage, current, or pulse-width, and the torque generated is a nonlinear function of the command and joint position. To enable the application of high performance in-contact control algorithms to commercially available robots, and thereby facilitate technology transfer from the robot control research community to commercial applications, an methodology has been developed to linearize the torque characteristics of electric motor-amplifier combinations. A four degree of freedom Adept 2 robot, having pulse-width modulation amplifiers and both variable reluctance and brushless DC motors, is converted to operate from joint torque commands to demonstrate the methodology. The commercial robot controller is replaced by a VME-based system incorporating special purpose hardware and firmware programmed from experimental data. The performance improvement is experimentally measured and graphically displayed using three-dimensional plots of torque vs command vs position. The average percentage torque deviation over the command and position ranges is reduced from as much as 76% to below 5% for the direct-drive joints 1, 2 and 4 and is cut by one half in the remaining ball-screw driven joint 3. Further, the torque deviation of the direct-drive joints drops below 2.5% if only the upper 90% of the torque range is considered. 23 refs., 20 figs., 2 tabs.

**34802** (SAND–91-1620C) **SNL initiatives in electronic fluxless soldering.** Hosking, F.M.; Frear, D.R.; Vianco, P.T.; Keicher, D.M. Sandia National Labs., Albuquerque, NM (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109259–9: 1. international congress on environmentally conscious manufacturing, Santa Fe, NM (United States), 18 Sep 1991). Order Number DE92000818. Source: OSTI; NTIS; GPO Dep.

Conventional soldering of electronic components generally requires the application of a chemical flux to promote solder wetting and flow. Chlorofluorocarbons (CFC) and halogenated solvents are normally used to remove the resulting flux residues. While such practice has been routinely accepted throughout the electronics industry, the environmental impact of hazardous solvents on ozone depletion will eventually limit or prevent their use. Solvent substitution or alternative technologies must be developed to meet these goals. Sandia National Laboratories, Albuquerque has a comprehensive environmentally conscious electronics manufacturing program underway that is funded by the DOE Office of Technology Development. Primary elements of the integrated task are the characterization and development of alternative fluxless soldering technologies that would eliminate circuit board cleaning associated with flux residue removal. Storage and handling of hazardous solvents and mixed solvent-flux waste would be consequently reduced during electronics soldering. This paper will report on the progress of the SNL fluxless soldering initiative. Emphasis is placed on the use of controlled atmospheres, laser heating, and ultrasonic soldering.

**34803** (SAND–91-1756C) **Overlooked fundamentals of resistance welding.** Knorovsky, G.A. Sandia National Labs., Albuquerque, NM (United States). [1991]. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911003–15: Fall meeting of the Minerals, Metals and Materials Society of AIME and Materials Week of the American Society of Metals, Cincinnati, OH (United States), 20-24 Oct 1991). Order Number DE91018814. Source: OSTI; NTIS; GPO Dep.

Resistance Welding (RW) has been known for about a century and in common use for much of that time. Much knowledge has been accumulated concerning many aspects of the process. However, upon examining contemporary RW handbooks, a few subjects that have been "overlooked" were found. Usually, this oversight will not be important; however, when the RW process is being applied at its limits, these factors may become critical. In this paper we will discuss such "overlooked" factors as the Peltier and Thomson effects, and the dynamics of welding head motions and how they are affected by the current pulse. Examples taken from sheet metal and microwelding applications will be given as examples. 12 refs., 7 figs., 4 tabs.

**34804** (UCRL-CR–107270) **Control-Structure-Interaction (CSI) technologies and trends for future NASA missions: Final report [December 9, 1988–December 16, 1989].** Turner, J. (Photon Research Associates, Inc., Cambridge, MA (United States). Cambridge Research Div.). Lawrence Livermore National Lab., CA (United States); National Aeronautics and Space Administration, Hampton, VA (United States). Langley Research Center; Photon Research Associates, Inc., Cambridge, MA (United States). Cambridge Research Div. Dec 1990. 103p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018996. Source: OSTI; NTIS; GPO Dep.

The objective of the study has been to review Control-Structure-Interaction (CSI) issues which are relevant for NASA systems. This goal has been achieved by: (1) reviewing large space structures (LSS) technologies to provide a background and survey of the current state-of-the-art (SOA) (2) analytically studying a focus mission to identify opportunities where CSI technology may be applied to enhance or enable future NASA spacecraft and, (3) expanding a portion of the focus mission, the large antenna, to provide in-depth trade studies, scaling laws, and methodologies which may be applied to other NASA missions. The basic conclusions which follow

from the study presented in this report are: passive damping approaches provide significant benefits, increasing the structural mass does not significantly reduce the interaction of the control and structural system, control and/or passive damping technologies are required for most missions beyond 20m, demonstrated levels of broadband control capabilities will likely require further experimentation to establish the predicted two orders of magnitude response suppression capabilities. 88 refs., 13 figs., 19 tabs.

**34805** (Y/TR–91/1) **Continuous centrifugal separator for slurries.** Hamada, Fumio (3012-15 Todo, Tama-ku, Kawasaki-shi, Kanagawa-ken (Japan)). Oak Ridge Y-12 Plant, TN (United States). [1991]. 29p. Translation of Japanese Kokai Patent Hei 2[1990]-126954, May 15, 1990. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91018483. Source: OSTI; NTIS; GPO Dep.

This invention pertains to a centrifugal separator for separation treating large volumes of slurries containing clay and various other solid substances, such as polluted water or sludge from slush, sewage, etc., which are construction hazards, by using centrifugal force on such solid substances and water. The invention consists of a continuous centrifugal separator for slurries that is characterized by supporting a separator, inside of which a separation chamber is formed so that it rotates continuously at high speeds with a vertical axis as the center; forming a discharge opening on the outside of the above separation chamber to discharge separated solid substances, as well as forming a discharge opening near the center of the separation chamber to discharge separated water; a separating hose, which leads slurry such as slush and sludge, which are the objects from the outside that are to be separated, to the separator and from the separator at either the top or bottom of the separator, and maintaining it there, as well as passing it, apart from the separator, from this maintained position through the outside of the separator and coupling the tip to the center of the separator on the side opposite the above maintained position; and by constructing the outside part of the separator of the above hose so that it rotates, with the rotation axis of the separator as the center, in the same direction as the rotation direction of the separator with $\frac{1}{2}$ as many revolutions as the number of separator revolutions, without the hose rotating about itself. 10 figs.

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*Refer also to citation(s) 33562, 33619, 33864, 34008, 34060, 34353, 35070, 35182*

**34806** (ANL–90/45) **COMMIX-1AR/P: A three-dimensional transient single-phase computer program for thermal hydraulic analysis of single and multicomponent systems: Volume 1, Equations and numerics.** Blomquist, R.N.; Garner, P.L; Gelbard, E.M. Argonne National Lab., IL (United States). Jul 1991. 138p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE91018703. Source: OSTI; NTIS; GPO Dep.

The COMMIX-1AR/P computer code is designed for analyzing the steady-state and transient aspects of single-phase fluid flow and heat transfer in three spatial dimensions. This version is an extension of the modeling in COMMIX-1A to include multiple fluids in physically separate regions of the computational domain, modeling descriptions for pumps, radiation heat transfer between surfaces of the solids which are embedded in or surround the fluid, a k-$\varepsilon$ model for fluid turbulence, and improved numerical techniques. The porous-medium formulation in COMMIX allows the code to be applied to a wide range of problems involving both simple and complex geometrical arrangements. The basic equations, underlying assumptions, and solution techniques are presented for the entire computer code, covering both old and new features. 37 refs., 18 figs., 17 tabs.

**34807** (ANL/MFRI–8) **Implementation of the flow-modulated skew-upward difference scheme in the momentum equation of the COMMIX-1C program: A first assessment.** Shen, Y.; Bottoni, M.; Sha, W.T. Argonne National Lab., IL (United States). Multiphase Flow Research Inst. Feb 1991. 99p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE91018013. Source: OSTI; NTIS; GPO Dep.

Based on the concept of feedback sensitivity in the analysis of stability behavior of discretized partial differential equations, central differences, when applied to even-order derivatives yield stable algorithms, while applied to odd-order derivatives they yield algorithms without inherent stability. In a low-convection, diffusion-dominated flow, in which both convective and diffusive terms are discretized with central differences, the stabilizing effect of the diffusion term is sufficient to allow stability; in a flow dominated by convection, the stabilizing effect of the diffusion term becomes weaker and cannot prevent wiggles that finally lead to instability. In the case of two-dimensional flow, numerical diffusion depends on the skewness of the flow with respect to the grids. The numerical diffusion can be reduced by considering upstream values of the dependent transported variables, taken following the stream lines. Variants of the skew-upwind difference (SUD) scheme have been obtained by taking into account either mass flows or cell surface areas or cell volumes to properly weight the contributions of the cells involved in the discretization process. The mass-flow-weighted SUD scheme has been developed in the three-dimensional case and implemented in the energy equation of the COMMIX-1A code. The volume-weighted SUD scheme was likewise implemented in the three-dimensional energy equation of the variant COMMIX-1B. Problems in the application of the SUD scheme arise when the flow is so skewed that the contributions of upwind cells become much smaller than the contributions of neighboring cells. The problem has been tackled with the development of a new algorithm, the flow-modulated skew-upwind difference (FMSUD) scheme. The report explains test cases in which the implementation of the FMSUD scheme has been applied. 25 figs., 2 tabs.

**34808** (CONF-8906112–, pp. 1-8) **Radiation heat transfer in particulate systems.** Tien, C.L. (Univ. of California, Irvine (USA)). Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences: Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

This paper summarized the advances achieved during the first two years of the DOE Grant DE-FG03-87ER13783 and outlines the continuing research for the following year. Research progress accomplished in the first two years includes the formulation of analytical models to determine dependent absorption and scattering properties of densely-packed particulate systems and finite agglomerates, the application of this theory to radiative transfer in packed and fluidized beds and in porous media, and the development of a solution methodology for solving the general equation of radiative transfer. The continuing research effort in the next year will focus on applying the concepts used to analyze effects on radiation heat transfer, and the influence of radiation on liquid droplet combustion. Additionally, an exploratory study on the radiative properties of thin-film high-temperature superconductors has been initiated.

**34809** (CONF-8906112–, pp. 9-16) **Boiling incipience in wavy falling liquid films.** Mudawar, I. (Purdue Univ., West Lafayette, IN (USA)). Argonne National Lab., IL (United States). [1989]. DOE Contract FG02-85ER13398. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Experiments were performed to examine the influence of interfacial waves on the incipience of nucleate boiling in wavy falling water films. It is shown that common incipience theory fail to predict incipience conditions in thin films due to the influence of turbulent eddies on temperature in the superheated liquid layer adjacent to the wall. Simultaneous measurements of film thickness and temperature distribution across the film reveal waves produce significant transient changes in the temperature gradient within the superheated layer. Results of a new model for predicting the incipient heat flux and wall superheat in turbulent wavy films are presented. The model involves parameters of common incipience theory and provides a means for correcting these theory for the effects of turbulent eddies and interfacial waves.

**34810** (CONF-8906112–, pp. 17-24) **Nucleate pool boiling from a horizontal wire in aqueous polymer solutions.** Hu, Robert Y.Z. (Univ. of Illinois, Chicago (USA)); Hartnett, J.P. Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences: Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

The nucleate pool boiling behavior of viscoelastic aqueous polymer solutions has been measured and compared with results for pure water. Two polymers were used in the study, a polyacrylamide (Separan AP-30) of 6 concentrations ranging from 60 wppm to 2,000 wppm and a hydroxyethylcellulose (Natrosol 250HHR) of 6 concentrations ranging from 500 wppm to 5,000 wppm. The conventional $q''$ vs $\Delta T$ boiling curves were measured using an electrically heated horizontal platinum wire of diameter 0.0254 cm submerged in a saturated pool of liquid at atmospheric pressure. The steady shear viscosity of each polymer solution was measured before and after boiling to ensure that the rheological properties were relatively stable during the boiling process. A quantitative measure of the elasticity of these solutions was obtained by subjecting the fluid to an oscillatory motion and measuring the phase shift between the input frequency and the output response. The water boiling data are in fair agreement with Nishikawa's and Kutateladze's correlations. The boiling heat transfer performance of the Separan solutions was inferior to the performance of water, exhibiting larger values of $\Delta T$ at a fixed heat flux, $q''$. In the case of the Natrosol solutions the 500 wppm solution showed a slight improvement over the performance of water; for concentrations above 1,000 wppm dramatically different behavior was observed. For these higher concentration Natrosol solutions heat transfer enhancement was observed at heat fluxes above 13 $W/cm^2$. In this region, the surface temperature of the platinum wire actually decreased with an increase in the heat flux. A series of photographs of the boiling processes provided additional support for the measured $q''$ vs $\Delta T$ behavior of the polymer solutions.

**34811** (CONF-8906112–, pp. 93-107) **Recent progress in lattice gas automata.** Hasslacher, B. (Univ. of California, San Diego (USA)). Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

The first successful application of a microscopic analogy to create a skeleton cellular automaton and analyze it with statistical mechanical tools, was the work of Frisch, Hasslacher and Pomeau on the Navier-Stokes equation in two and three dimensions. Cellular automata have been constructed for statistical mechanical models, fluids, diffusion and shock systems in fundamental investigation. In applied areas, which are here a short step from fundamental ones, there are now working cellular automata models for complex flows through porous media, chemical reaction and combustion dynamics, multiphase flow systmes, plasma and wave computations and fluids mixtures with natural boundaries. With extended cellular fluid models, one can do problems with arbitrary pairwise potentials. Recently, these have been applied to such problems as non-newtonian or polymeric liquids and a mixture of immiscible fluids passing through fractal or spongelike media in two and three dimensions.

**34812** (CONF-8906112–, pp. 137-144) **The formation of lateral intrusions in a thermohaline stratification.** Thomas, E. (Stanford Univ., CA (USA)); Schladow, S.G.; Koseff, J.R. Argonne National Lab., IL (United States). [1989]. DOE Contract FG03-87ER13757. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

A study of mixing processes in doubly diffusive systems is being conducted. Continuous gradients of temperature and salinity are being used as initial conditions, and forcing is introduced by lateral heating and surface shear. The goals of the proposed work include: (1) quantifying the effects of finite amplitude disturbances on stable, double diffusive systems, particularly with respect to lateral heating, (2) increasing our knowledge-base of turbulent flow in stratified environments and how to represent it, and (3) formulation of a numerical code for such flows. Using two dimensionless parameters to classify stability, the authors have distinguished three regimes of intrusions. Subsequent merging of these intrusions is shown to be the result of horizontal entrainment and amalgamation, rather than by the equalization of densities in the vertical direction.

**34813** (CONF-8906112–, pp. 145-153) **Effect of convection on solidification in a binary mixture.** Incropera, F.P. (Purdue Univ., West Lafayette, IN (USA)); Neilson, D.G.; Prescott, P.J. Argonne National Lab., IL (United States). [1989]. DOE Contract FG02-87ER13759. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

A continuum model has been developed for predicting solidification of a binary substance under conditions for which convection influences species and energy transport in the liquid (melt) and solid/liquid (mushy) regions. By using a single set of equations to predict transport phenomena in the melt, mushy and solid regions, the need to impose ill-defined interface conditions, which is a requirement of alternative multi-domain formulations, is eliminated. Calculations performed for two-dimensional rectangular and cylindrical castings have yeilded many previously observed qualitative features of the solidification process, which include double-diffusive layering in the melt, development of an irregular liquidus front, remelting of solid, and the establishment of characteristic constituent segregation patterns. However, quantitative comparisons of model predictions with measurements of solidus and liquidus front locations and temperature and composition fields in the melt have been less favorable.

**34814** (CONF-8906112–, pp. 154-164) **Turbulence structure in liquid streams bounded by a free surface and a solid wall.** Banerjee, S. (Univ. of California, Santa Barbara (USA)); Fenech, H.; Hetsroni, G.; Rashidi, M.; Lam, Kin; Plachta, R.; Vandenbroek, M. Argonne National Lab., IL (United States). [1989]. DOE Contract FG03-85ER13314. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

A program is being undertaken in the authors laboratories to clarify aspects of turbulence structure near fluid-fluid interfaces. Key issues relate to the evolution of organized structures generated in regions of shear and their interaction with the interface. They have found that in the absence of shear at the interface, the dominant structures arise at the wall as bursts of intensely turbulent fluid, with low streamwise momentum, that penetrate sufficiently into the flow to reach the interface. These structures persist even after interacting with the interface in that they appear to roll over and give rise to a characteristic rotational motion in the liquid layer. When shear is imposed at the interface, qualitatively similar phenomena to that observed at solid walls appear to occur, i.e. longitudinal streaks of low and high speed fluid are seen very close to the interface and these are periodically destabilized and ejected into the bulk flow as bursts. The formation of these structures appears to depend on shear rate and is relatively independent of boundary conditions.

**34815** (CONF-8906112–, pp. 165-173) **Inertial deposition of aerosols from channel flow.** McLaughlin, J.B. (Clarkson Univ., Potsdam, NY (USA)). Argonne National Lab., IL (United States). [1989]. DOE Contract FG02-88ER13919. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

The trajectories of rigid spherical aerosols are computed using a pseudospectral computer program to simulate the three-dimensional, time-dependent flow field. It is assumed that the

channel is vertical so that gravity can not directly cause the deposition of aerosols on the wall. The aerosols are assumed to be sufficiently small and widely separated that their influence on the fluid velocity field can be ignored. The results reveal a number of unexpected phenomena including an accumulation of aerosols in the viscous sublayer and the fact that the deposition of aerosols is controlled by extremely strong sweeps in which the normal component of velocity in the viscous sublayer becomes comparable in magnitude to the fluctuations in the core of the channel.

**34816** (CONF-8906112–, pp. 174-184) **The remobilization of the interfaces of moving bubbles and drops retarded by surfactant adsorption.** Stebe, K.J. (City Coll. of New York, NY (USA)); Maldarelli, C. Argonne National Lab., IL (United States). [1989]. DOE Contract FG02-88ER13820. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Surfactant molecules adsorb onto the interfaces of moving fluid particles and are convected to regions in which the surface flow converges. Accumulation of surfactant in these regions creates interfacial tension gradients which retard the surface flow. In this study a theory of remobilization is advanced.It is suggested that if diffusion and sorption kinetic barriers are not present, then surfactant molecules rapidly exchange between the bulk and the surface creating a uniform concentration of surfactant, and the interfacial flow remains unhindered because no gradients develop. The theory is verified in a three phase slug flow. The major applicaton of this theroy is the idea that a surface retarded by the adsorption of a surfactant with limited exchange with the bulk (as, for example, in the case of a trace surface active impurity with diffusion barriers created by the low concentration) can be remobilized by displacing the immobilizing surfactant through competitive adsorption with a surfactant with no barriers to exchange. This idea is also verified in the three phase flow regime.

**34817** (CONF-8906112–, pp. 185-195) **Interfacial area in two-phase flow.** Ishii, M. (Purdue Univ., West Lafayette, IN (USA)); Tan, M.J. Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Knowledge of interfacial area is required for analysis and prediction of transient and steady characteristics of two-phase flow systems using the two-fluid models. Based on a survey of published work on the subject of interfacial area, it is recognized that there is virtually no data base for local interfacial area. This paper describes the ongoing development of interfacial area models and experimental techniques for meausrement of local interfacial area concentration in gas-liquid and liquid-liquid two-phase systems. Mathematical relations between local interfacial area concentration and meausrable quantities are derived based on kinematics and geometry. Two methods for determining local interfacial area are identified; both entail detection of passage of interfaces through fixed locations in the flow field. A multiple-sensor electrical-resistivity-probe technique is being developed for determination of local interfacial area in vertical gas-liquid bubbly flows. The technique consists of simultaneous measurements at two or four locations in the two-phase flow field of the local electrical resistivity of the two-phase mixture. Methods for data analysis are described. Limitations of the technique are briefly discussed.

**34818** (CONF-8906112–, pp. 196-203) **Maximum fluid particle size.** Kocamustafaogullari, G. (Univ. of Wisconsin, Milwaukee (USA)). Argonne National Lab., IL (United States). [1989]. DOE Contract FG02-87ER13764. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

A simple mechanistic model is developed based on the combination of Kelvin-Helmholtz and Rayleigh-Taylor instability theory to describe the breakup of freely rising or falling fluid particles, i.e., bubbles and drops. The breakup is predicted to occur if the growth rate of interfacial waves on the leading front is faster than the rate at which waves propagate around the interface to the side of the particle. Based on this theoretical model and available experimental data, simple correlations are developed to predict the maximum size a fluid particle can reach. Predicted values of the breakup diameter are compared with experimental data for cases of freely rising bubbles, falling drops in gas, and freely falling or rising drops in immiscible liquids. The results are extended to predict the mixi-mum droplet size in a high velocity gas field which is the most interesting case in terms of practical applications. Good agreement between predicted values and experimental data indicates that the principal mechanisms involved in the fluid particle breakup process are properly accounted for by the proposed model.

**34819** (CONF-8906112–, pp. 204-211) **Theories on the initiation of slug flow.** Hanratty, T.J. (Univ. of Illinois, Urbana (USA)). Argonne National Lab., IL (United States). [1989]. DOE Contract FG02-86ER13556. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Theoretical progress in understanding the initiation of slugging for gas-liquid flows in horizontal pipes is reviewed. One approach is to consider the stability of a stratified flow to long or short wavelength disturbances. In the latter case it is suggested that the first step in the evolution to slugs could be a bifurcation triggered by a Kelvin-Helmholtz instability. A second approach is to examine the stability of slugs; this is to establish necessary conditions for their existence.

**34820** (CONF-8906112–, pp. 212-217) **Stochastic effects near the convective onset.** Meyer, C.W. (Univ. of California, Santa Barbara (USA)); Cannell, D.S.; Ahlers, G. Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

The results of recent experiments probing the initial stages of pattern formation in Rayleigh-Benard convection are presented. Unless extraordinary measures are taken, horizontal temperature gradients induced by the sidewalls result in flows which reflect the container geometry and penetrate inward from the walls. When such forcing is reduced sufficiently the initial stages are observed to involve random cellular flow emerging tohroughout the entire cell, and gradually healing to roll-like flow. Results for the convective heat current can be modeled using the amplitude equation with either a constant or a stochastic forcing term.

**34821** (CONF-8906112–, pp. 218-225) **Vortex dynamics in elliptic jets.** Husain, H.S. (Univ. of Houston, TX (USA)); Hussain, F. Argonne National Lab., IL (United States). [1989]. DOE Contract FG05-88ER13839. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

The concepts of vortex dynamics, especially the deformation of noncircular vortex rings and cross-linking of antiparallel viscous vortices, have been used to explain many peculiarities of elliptic jets. In an elliptic jet, the vortical structures undergo curvature-dependent self-induction similar to an isolated elliptic vortex ring, causing the axes of the jet cross-section to switch. The number of axis switchovers and their locations and hence the jet characteristics can be altered by changing initial condition, aspect ratio and frequency and amplitude of excitation. For jets of high aspect ratios, ring deformation is so severe that each advecting vortical structure is split into two rings via cut-and-connect interaction, causing the jet to bifurcate. Deformation and cut-and-connect of structures in elliptic jets produce enhanced mixing - much more than possible in circular jets. Preferred mode coherent structures and pairing mechanisms of deforming structures in an elliptic jet have also been investigated using phase-locked hot-wire measurements and flow visualization.

**34822** (CONF-8906112–, pp. 226-236) **An experimental study of helicity and related properties in turbulant flows.** Wallace, J.M. (Univ. of Maryland, College Park (USA)); Balint, J.L. Argonne National Lab., IL (United States). [1989]. DOE Contract FG05-88ER13838. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Probability density distributions (PDDs) of the relative helicity density, i.e. the cosine of the angle between the velocity and vorticity vectors, for a turbulent boundary layer, a two-stream turbulent mixing layer, and a turbulent grid flow have been experimentally determined. The PDDs show that there is a higher probability for the two vectors to align within the logarithmic region of the boundary layer and in the mixing layer than there would be for two uncorrelated isotropic vector fields. In the buffer layer region of the boundary layer and in the grid flow there is virtually no preferential tendency for these vectors to align. There is also nearly no increased probability of alignment when the PDDs are conditioned either on high or low instantaneous dissipation.

**34823** (CONF-911213–3) **Measurements of heat and mass transfer coefficients during absorption of water vapor by lithium bromide and (Li,K,Na)$NO_3$ mixtures.** Zaltash, A.; Ally, M.R.; Linkous, R.L.; Klatt, L.N. Oak Ridge National Lab., TN (United States). [1991]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) annual winter meeting; Atlanta, GA (United States); 1-6 Dec 1991. Order Number DE91014212. Source: OSTI; NTIS; GPO Dep.

A knowledge of heat and mass transfer coefficients in heat pump fluids, plays an important role in the design of absorption machines. Heat and mass transfer coefficients as well as subcooling are measured for absorption of water vapor in (Li, K, Na)$No_3$ and Lithium Bromide (LiBr) mixtures.The rate of absorption of water vapor is obtained from the difference in concentration of mixtures between inlet and outlet streams across the absorber. In situ concentrations of aqueous salt mixtures over temperature ranges between 80 to 135 °C were calculated from density measurements. This technique of measurement is a reliable and convenient but not a very accurate (±0.8 wt% salt) method of measuring the in situ salt concentration. Results show that the subcooling at the absorber exit is not only a property of the fluid, but depends strongly on the process conditions. The subcooling in LiBr mixtures without additive is shown to vary between 2.2 and 24.3 °C and the film heat transfer coefficient between 1365.2 and 801.1 $W/m^2.K$ respectively, depending upon process conditions. These empirical results will prove to be of value to heat pump manufacturers because they have a strong bearing on costs and performance. Heat and mass transfer coefficients in aqueous salt solutions ate presented as a function of dimensionless numbers. 12 refs., 3 figs., 4 tabs.

**34824** (CONF-911213–4) **Thermal performance analysis for heat exchangers having a variable overall heat transfer coefficient.** Conklin, J.C. (Oak Ridge National Lab., TN (USA)); Granryd, E. Oak Ridge National Lab., TN (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) annual winter meeting; Atlanta, GA (United States); 1-6 Dec 1991. Order Number DE91015633. Source: OSTI; NTIS; GPO Dep.

The classic, conventional analysis for the thermal performance of heat exchangers is based on three assumptions: constant fluid flow rate, constant specific heat fluids, and constant overall heat transfer coefficient. Our analysis describes a general approach for analyzing the thermal performance of heat exchangers in which the overall heat transfer coefficient varies as a function of enthalpy, with the other two basic assumptions of constant mass flow rates and constant specific heats unchanged. Many heat exchangers have an overall heat transfer coefficient that is not constant. The conventional heat exchanger thermal performance analysis is correct as long as a true, area-weighted mean value is used. In many applications, however, fluids undergo a change in phase, and the heat transfer coefficient is a function of the local quality or enthalpy: hence, the true. area-weighted, mean heat transfer coefficient will be a function of the heat flux distribution. Examples are presented that illustrate the variation in overall heat transfer coefficient for an evaporation process. We present a general method for computing a true, area-weighted mean overall heat transfer coefficient that permits use of a local overall heat transfer coefficient that is an arbitrary function of enthalpy. This method allows a simple yet accurate analysis of the effects of a variable overall heat transfer coefficient to be made without the use of a large mainframe computer. We then investigate (1) linear variation of local overall heat transfer coefficient with respect to enthalpy and (2) two heat transfer correlations applicable to flow-boiling inside a tube. 9 refs., 5 figs., 4 tabs.

**34825** (DOE/ER/13820–1) **Periodically structured multiphase flows and hydrodynamic instabilities in narrow capillaries: Final report.** Maldarelli, C. City Univ. of New York, NY (United States). Research Foundation. May 1991. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13820. Order Number DE91018802. Source: OSTI; NTIS; GPO Dep.

This is the final report of the research completed under the auspices of the Department of Energy grant "Periodically Structured Multiphase Flows and Hydrodynamic Instabilities in Narrow Capillaries". The research studies the mobility of train flows of fluid slugs moving in narrow capillaries. This type of flow regime often develops in enhanced oil recovery applications when saturating oil is removed from rock pores by displacing with a second immiscible phase which is usually an aqueous surfactant solution. The exact type of flow pattern which emerges as the gaseous phase displaces the saturating oil depends on whether the oil or the aqueous solution preferentially wets the pore walls. If the oil is more strongly wetting, then the displacement takes the form of a winding train of long aqueous slugs separated by pools of oil and riding over a thin cushion of the oil. Alternatively, if the aqueous solution is more strongly wetting, then the fluids change places, and the displacement consists of slugs of oil moving over an aqueous film. The effectiveness of the oil removal is largely a function of the mobility of the slug train as is transverses the rock bed. If the train frequently gets stuck, or slows down considerably in places, then the aqueous solution is unable to effectively remove the oil. This research focuses on two factors which control the slug train mobility, the absorption of surfactants onto the slug interfaces and the stability of the thin cushions or wetting layers along which the slugs move. 10 figs.

**34826** (ETDE-mf–2711162) **Investigation on condensation and evaporation of static droplets in gas-vapor mixtures by means of a shock wave tube.** Paikert, B. Essen Univ. (Gesamthochschule) (Germany). Fachbereich 12 - Maschinentechnik. 21 Dec 1990 136p. (In German). Order Number DE92711162. Source: OSTI; NTIS (US Sales Only).

The method used for the experimental investigation of the nucleation, condensations and evaporation of droplet used here a gasdynamic shock tube process in connection with a Mie Streulichtverfahren. Six different steam/carrier gas/combinations were investigated. Water, methanol, ethanol, n-propanol or n-hexane were used as steam. Argon and air are the carrier gases. Chapter 2 handles the fundamentals of the classical nucleation theory; the preconditions and consequences of theory are represented and discussed. Chapter 3 describes the growth of a resting single droplets in an infinitely three-dimensional environment. The time until the velocity relaxation is negligible in the case of the droplet quantities and environmental conditions which were examined here compared to the growth time; growth is not influenced by a possible difference between droplet velocity and gas velocity in a flow. The growth of resting droplets can therefore be observed. The model describes growth as a heat and mass transfer problem under combination of molecular and continuum transport mechanisms. Chapter 4 gives a summary on nucleation and growth experiments in literature. The different experimental setups are represented in detail in order to clarify their advantages and disadvantages. The method which the author used is described in chapter 5. Chapter 6 contains a representation and discussion of the nucleation results. Chapter 7 contains the results of the growth experiments. Chapter

8 describes an alternative method for the measurement of the nucleation rate which is based on the photographic diagram of the droplets. The limits of applicability of the growth model and the measuring method are discussed in chapter 9. (orig.).

**34827** (INIS-mf–14013) **Experimental investigation of turbulent flows in pipe junctions.** Neikes, R. Technische Hochschule Aachen (Germany). Fakultaet fuer Maschinenwesen. 24 Oct 1989 168p. (In German). Order Number DE92714465. Source: OSTI; NTIS (US Sales Only); INIS.

Branching, three-dimensional, incompressible internal flows are examined in detail in circular pipe configurations at an experimental plant for water and at a test bench for air. Laminar and turbulent flows are made visible in water for $Re<5x10^4$. Typical phenomena are described in detail, e.g. separations, secondary flows and locally non-stationary behavior under stationary inflow conditions and outflow conditions. Wall pressure distributions for turbulent flows up to $Re=10^5$ measured at the same test bench supply a good explanation for a number of observed effects. A quantitative investigation of turbulent velocity fields of selected flow cases up to outflow lengths of 10D is carried out in air with the aid of hot-wire anemometry. (orig./DG).

**34828** (JAERI-M–91-086) **MINI-TRAC code: a driver program for assessment of constitutive equations of two-fluid model.** Akimoto, Hajime (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Abe, Yutaka; Ohnuki, Akira; Murao, Yoshio. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1991. 478p. (In Japanese). Order Number DE92704099. Source: OSTI; NTIS (US Sales Only); INIS.

MINI-TRAC code, a driver program for assessment of constitutive equations of two-fluid model, has been developed to perform assessment and improvement of constitutive equations of two-fluid model widely and efficiently. The MINI-TRAC code uses one-dimensional conservation equations for mass, momentum and energy based on the two-fluid model. The code can work on a personal computer because it can be operated with a core memory size less than 640 KB. The MINI-TRAC code includes constitutive equations of TRAC-PF1/MOD1 code, TRAC-BF1 code and RELAP5/MOD2 code. The code is modulated so that one can easily change constitutive equations to perform a test calculation. This report is a manual of the MINI-TRAC code. The basic equations, numerics, constitutive, equations included in the MINI-TRAC code will be described. The user's manual such as input description will be presented. The program structure and contents of main variables will also be mentioned in this report. (author).

**34829** (KFK–4773) **HEPAFIL - a program for the calculation of the fluid dynamics of high efficiency particulate air filter units.** Schlehuber, F.; Fronhoefer, M; Neuberger, M. Kernforschungszentrum Karlsruhe GmbH (Germany). Lab. fuer Aerosolphysik und Filtertechnik (LAF); Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Nukleare Sicherheitsforschung. May 1991. 48p. Order Number DE92714468. Source: OSTI; NTIS (US Sales Only); INIS.

With HEPAFIL, LAF II provides a FORTRAN program for the calculation of various parameters associated with the fluid dynamics of high efficiency particulate air filter units. Most of the currently available commercial deep pleat designs have been taken into consideration, e.g., high strength nuclear grade units employing separators with inclined corrugations, units for clean room applications, as well as low and medium efficiency EU 6 and EU 8 types having very low pressure drops. The flow resistance curves obtained from HEPAFIL could be verified in extensive experimental test. A user-friendly PC version with the integrated program library HEPAGAS can serve as a useful tool to the researcher in filter development as well as to the filter manufacturer for cost reduction analyses. Knowledge of the distributions of airstream, pressures and velocities within the flow channels of the filter pack allows more precise investigations of failure mechanisms and filtration characteristics for a wide range of flow conditions. The newest scientific application involves fundamental investigations into the cleanability of HEPA filter units. HEPAFIL offers filter manufacturers the opportunity to improve and optimize filter performance with respect to pressure drop, burst strength, and material costs, with a minimum of prototype fabrication and testing. (orig.).

**34830** (KFK–4860) **Benard convection in a two component system with Soret effect.** Zimmermann, G.; Mueller, U. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Reaktorbauelemente. May 1991. 57p. Order Number DE92711512. Source: OSTI; NTIS (US Sales Only).

Flow visualization experiments are reported which study Rayleigh-Benard convection in a two component system with Soret effect. Differential interferometry in combination with local temperature records inside the liquid layer is employed to analyse the spatial and temporal behavior of the convection in a slender test cell of dimension height:depth:width=0.31:2:20. Travelling roll patterns of transient and permanent character as well as steady overturning convection are observed depending on the range of Rayleigh numbers. The transitions from the static state of conduction to the travelling wave state and the transition from travelling waves to steady convection is affected by hysteresis. The frequencies associated with the travelling waves are determined and compared with predictions of linear stability analysis and interpreted in terms of solute transport and mixing along streamlines. The observations are in agreement with results reported in the literature. An unexpected feature is that the range of occurrence of the permanent state of travelling waves shrinks with a decreasing mean temperature of the liquid layer, and moreover disappears for mean temperatures below 5deg C. We attribute this effect to the increasing nonlinearity in the density-temperature relation at low temperatures. (orig.).

**34831** (SAND–91-0828C) **Three-dimensional simulations of airflow through an electrically heated screen using the spectral-element code NEKTON.** Torczynski, J.R. Sandia National Labs., Albuquerque, NM (United States). [1991]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109264–1: 1991 CREARE.X software users meeting, Burlington, VT (United States), 17-19 Sep 1991). Order Number DE91018350. Source: OSTI; NTIS; GPO Dep.

The spectral element computational fluid dynamics code NEKTON (Nektonics/Creare.x) is used to simulate airflow through an electrically heated screen. The inflow velocity of the air is uniform, constant, and oriented normal to the screen, which is taken to be a flat plate with a square array of circular holes. A voltage difference imposed across the screen sets up an electrical current within it for resistive heating. NEKTON is used to solve the Navier-Stokes equations, the energy transport equation, and Laplace's equation to determine the fluid flow through and downstream of the screen, the heat transport within both the fluid and the screen, and the voltage distribution (and resultant resistive heating) within the screen, respectively. Steady solutions are presented for wire-width Reynolds numbers in the 5–10 range. Difficulties related to this application of NEKTON are discussed. 4 refs., 7 figs., 4 tabs.

**34832** (TTKK-LT–69) **The phenomena of scalar mixing in turbulent gas-particle flows, measuring equipment and measurements.** Karema, H.; Laurila, R. Tampere Univ. of Technology (Finland). Thermal Engineering. 1989. 118p. (In Finnish). Order Number DE92704034. Source: OSTI; NTIS (US Sales Only).

LIEKKI Research Programme.

The phenomena of scalar mixing in turbulent gas-particle flows up to the loading ratio two is studied in upward flow conditions using spherical equal sized particles as the dispersed phase and air as the conveying phase. The tracer gas is injected isokineticly and isothermally in the parallel gas-particle flow and the time mean profile of the concentration is measured using suction probe connected to the infrared analyzer. These profiles are fitted to the similarity solution derived assuming the gradient diffusion model for the mixing process leading to the approximate value of the diffusivity.

## 4205 Materials Testing

*Refer also to citation(s) 33843, 34538, 34546, 34977*

**34833** (CONF-9110122–10) **Seismic shake table testing program for hollow clay tile wall evaluation at DOE facilities in Oak Ridge, Tennessee.** Walls, J.C. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States)); Webb, D.S.; Stone, N.E.; Bennett, R.M. Oak Ridge National Lab., TN (United States).

[1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Natural phenomena hazards mitigation conference; St. Louis, MO (United States); 15-18 Oct 1991. Order Number DE92000074. Source: OSTI; NTIS; GPO Dep.

A seismic test facility located at the K-25 Site in Oak Ridge, Tennessee, has been refurbished after shutdown since 1985. The facility shake table is being recertified in order to provide seismic testing capability to an extensive multi-year evaluation program of hollow clay tile walls in buildings at the DOE site in Oak Ridge. The program, directed by teh Center for Natural Phenomena Engineering at Martin Marietta Energy Systems, Inc., the managing contractor for DOE in Oak Ridge, is reviewed. Emphasis is given to the recertification efforts for the seismic test facility, and results of facility and specimen testing to data are discussed and plans for future testing are reviewed. Features and capabilities of the shake table are presented. The dynamic testing of masonry structures is reviewed, and a hollow clay tile wall testing program is projected based on the shake table capability. 13 refs., 9 figs., 1 tab.

**34834** (FhG-IzfP–900126-TW) **Ultrasonic inspection of the inner and outer surfaces of components in contact with liquids using horizontally polarized shear waves. Final report.** Salzburger, H.J.; Huebschen, G. Fraunhofer-Institut fuer Zerstoerungsfreie Pruefverfahren, Saarbruecken (Germany); Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 16 Jul 1990. 81p. (In German). Contract BMFT 11L2080. Order Number DE92714277. Source: OSTI; NTIS (US Sales Only); INIS.

The report describes investigations and developments concerning ultrasonic techniques for the detection of cracklike and corrosive defects in vessels and pipes. Horizontally polarized shear (SH-)waves are used, which have advantageous features for these inspection tasks. Besides the complete corner reflection in the whole angle of incidence range and the grazing incidence along the near probe surface their propagation isn't influenced by liquids in contact with the surfaces. In thin walled components like plates and pipes (wall thickness $\leq$ 15 mm) these waves propagate as guided waves over large distances (up to 1 m) and are well suited for the inspection of large areas of these very commonly used components in the chemical industry. Free of couplant transmission and reception of these waves are realized by Electro-Magnetic Ultrasonic (EMUS)-transducers. The EMUS-technique is capable to perform inspections up to 300deg C without any cooling means by appropriate construction of the probes, so that the most components can be inspected at their temperatures of operation. Investigations have been performed concerning the detection of corrosive defects (wastage, pitting) in plates and tubes by guided SH-waves and cracklike defects - single cracks and crack-fields - by oblique incidence of bulk SH-waves. Laboratory measurements as well as trials in the field on real components have been carried out. (orig.).

**34835** (LA-UR–91-3052) **Atomic oxygen interaction with spacecraft materials: Relationship between orbital and ground-based testing for materials certification.** Cross, J.B. (Los Alamos National Lab., NM (United States)); Koontz, S.L.; Lan, E.H. Los Alamos National Lab., NM (United States). [1991]. 17p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109285–1: 5. international symposium on materials in space environment, Cannes (France), 16-20 Sep 1991). Order Number DE92000190. Source: OSTI; NTIS; GPO Dep.

The effects of atomic oxygen on boron nitride, silicon nitride, solar cell interconnects used on the Intelsat 6 satellite, organic polymers, and $MoS_2$ and $WS_2$ dry lubricant have been studied in low Earth orbit (LEO) flight experiments and in our ground-based simulation facility at Los Alamos National Laboratory. Both the in-flight and ground-based experiments employed in situ electrical resistance measurements to detect penetration of atomic oxygen through materials and ESCA analysis to measure chemical composition changes. In the presence of atomic oxygen, silver oxidizes to form silver oxide, which has a much higher electrical resistance than pure silver. Permeation of atomic oxygen through BN overcoated on thin silver was observed. No permeation of atomic oxygen through $Si_3N_4$ was observed. Test results on the Intelsat 6 satellite interconnects used on its photovoltaic array indicate that more than 60–80% of the original thickness of silver should remain after completion of the proposed Space Shuttle rescue/reboost mission. Gas phase reaction products produced by the interaction of high kinetic energy atomic oxygen (AO) with Kapton were found to be $H_2$, $H_2O$, CO, and $CO_2$ with NO being a possible secondary product. Hydrogen abstraction at high AO kinetic energy is postulated to be the key reaction controlling the erosion rate of Kapton. An Arrhenius-like expression having an activation barrier of 0.4 eV can be fit to the data, which suggests that the rate limiting step in the AO/Kapton reaction mechanism can be overcome by translational energy. Oxidation of $MoS_2$ and $WS_2$ dry lubricants in both ground-based and orbital exposures indicated the formation of $MoO_3$ and $WO_3$ respectively. A protective oxide layer is formed $\approx$30 monolayers thick which has a high initial friction coefficient until the layer is worn off.

**34836** (NAL-TM–630) **Acoustic emission on flexural fracture test of Sic/Al composites.** Sofue, Y. (National Aerospace Laboratory, Tokyo (Japan)); Ogawa, A. National Aerospace Lab., Chofu, Tokyo (Japan). Dec 1990. 16p. (In Japanese). Order Number DE92709534. Source: OSTI; NTIS (US Sales Only).

In order to comprehend acoustic emission (A.E.) characteristics required in nondestructive tests, fracture behaviour of SiC/Al composites was investigated using three-point flexural tests with A.E. measurement. Flexural tests were conducted for four types of piles specimens (0 ° unidirectional, 90 ° unidirectional, 0 °/90 ° ply, and ±45 ° ply) of the composite materials. Source locations and amplitude distribution of A.E. were measured, and A.E. characteristics were compared among different specimens. As a result, it was found that the 0 °/90 ° ply specimen and ±45 ° ply specimen generated A.E. more frequently than the 0 ° unidirectional ply specimen and 90 ° unidirectional ply specimen. The A.E. amplitude was above 98 db for the fibre breakage mode in the case of the 0 ° unidirectional ply and 0 °/90 ° ply specimen, while the 90 ° unidirectional ply and ±45 ° ply specimen produced an A.E. amplitude in the range of below 72 db for the interlaminar and interface fracture mode. 1 ref., 34 figs., 1 tab.

**34837** (SAND–91-1374C) **Hypervelocity launch capabilities to over 10 km/s.** Chhabildas, L.C. Sandia National Labs., Albuquerque, NM (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9110228–2: 13. AIRAPT international conference on high pressure science and technology, Bangalore (India), 7-11 Oct 1991). Order Number DE92000242. Source: OSTI; NTIS; INIS; GPO Dep.

Very high pressure and acceleration is necessary to launch flier plates to hypervelocities. In addition, the high pressure loading must be uniform, structured, and shockless, i.e., time-dependent to prevent the flier plate from either fracturing or melting. In this paper, a novel technique is described which allows the use of megabar level loading pressures, and $10^9$ g acceleration to launch intact flier plates to velocities of 12.2 km/s. 32 refs., 2 figs.

**34838** (UCRL-ID–108258) **Ductile-Brittle Transition Temperature testing of tungsten using the three-point bend test.** Lassila, D.H.; Magness, F.; Freeman, D. Lawrence Livermore National Lab., CA (United States). 5 Mar 1991. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000099. Source: OSTI; NTIS; GPO Dep.

Three-point bend tests were performed to determine the Ductile-Brittle Transition Temperatures (DBTTs) of forged and chemical vapor deposition (CVD) tungsten. Testing was performed under quasi-static conditions at temperatures between 23°C and 450°C using a forced-air environmental chamber. Load-displacement data from the three-point bend tests indicated that the constitutive behavior of the materials tested varied considerably. Finite element modeling of the three-point bend test was performed to investigate plastic strains induced in the samples during testing as a function of constitutive behavior. The modeling assumed plane stress conditions in the sample and simple bi-linear elastic-plastic constitutive behavior of the test material. The strains induced in the samples were found to be functions of both the yield stress and work hardening behavior of the materials. The use of the three-point bend

test to determine DBTT, and the DBTTs reported for the test materials, are discussed relative to the modeling results. It is concluded that the three-point bend test has some utility in the determination of DBTTs if some caution is used in the selection of test parameters and fixture geometries. However, the three-point bed test does not provide a complete picture of the nature of the ductile-brittle transition. 12 refs., 9 figs.

**34839** (UCRL-JC-104111-Rev.1) **Continuum x-ray gauging of multiple-element materials: Revision 1.** Lewis, D.L. (Lawrence Livermore National Lab., CA (United States)); Logan, C.M.; Gabel, M.R. Lawrence Livermore National Lab., CA (United States). Feb 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-910399-3-Rev.1: American Society for Nondestructive Testing spring conference, Oakland, CA (United States), 18-22 Mar 1991). Order Number DE91017429. Source: OSTI; NTIS; GPO Dep.

We have developed a system for elemental quantification of materials with known constituents. It utilizes an x-ray tube to generate a photon spectrum and an energy-dispersive detector to measure the photon transmission of a material at selected energies. The abundance of each element is then iteratively extracted using characteristic attenuation coefficients and the material bulk density and thickness. 7 figs.

## 4210 Combustion Systems

**34840** (RFP-Trans-515) **Twenty-five years of an electric furnace.** Borel, E.; Touvay, M. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. Jun 1990. 12p. Translated from: Advances in Glass Technology, VI International Congress on Glass, 196-204(1962). Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91018409. Source: OSTI; NTIS; GPO Dep.

Numerous papers have already appeared concerning the melting of glass by electrical heating. A certain number of these papers were written by persons who had truly experimented on the melting of glass by electrical heating either in the laboratory or in the plant. These papers are indicated in part in references at the end of this article. The objective of this article is not to examine in general the electrical melting of glass, but to consider a very particular and limited case, i.e., the melting of glass in a continuous furnace, by means of electrical energy and the use of graphite electrodes. Thus the question of other experiments already performed with metal electrodes such as molybdenum will not be treated here. This article will also be limited to a particular furnace type, i.e., the longitudinal convection furnace, intended for manufacture of window glass, and thus of exclusively sodium-calcium glass. 16 refs., 9 figs.

## 4250 Power Cycles

*Refer also to citation(s) 34027*

## 4260 Components, Electron Devices and Circuits

*Refer also to citation(s) 33773, 34220, 34324, 34357, 34431, 34521, 34567, 34572, 34589, 34802, 34858, 34859, 34862, 34871, 34872, 34881, 34884, 34895, 34897, 34899, 34906, 34907, 34908, 34909, 34912, 34914, 34915, 34916, 34917, 34919, 34942, 34951, 34952, 34959, 34978, 34983, 34984, 35131, 35374, 35491, 35506, 35519*

**34841** (ALS/TR-91-015) **Process for controlling the thickness of an antireflection coating, and embodying apparatus.** Landreau, J. (Centre National d'Etudes des Telecommunications (CNET), 92 - Issy-les-Moulineaux (France)); Nakajima, Hisao. Sandia National Labs., Albuquerque, NM (United States). 30 May 1991. 11p. Translation of European Patent Application Publication No. 0 407 298 A1, January 9, 1991. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91017634. Source: OSTI; NTIS; GPO Dep.

The object of this invention is a process for controlling the thickness of an antireflection coating, and an embodying apparatus. It is applicable in the antireflection processing of facets of semiconductor lasers. It is known that an antireflection coating whose index n satisfies the equation $n^2 = n_0$, where $n_{subc}$ is the index of the substrate onto which it is deposited, the thickness of which is equal to $\lambda/4n$, where $\lambda$ is the wavelength. For any given material, the thickness can be adjusted to obtain a good antireflection coating. It is considered that a "good" antireflection coating is a coating whose reflectivity is less than $10^{-3}$. This very low value imposes severe constraints on the thickness, which must be adjusted to better than $10^{-2}$. It is therefore relatively difficult to produce good antireflection coatings. 5 figs.

**34842** (ENEA-RT-INN-90-02) **Contributions to the international conference on laser '89.** ENEA, Casaccia (Italy). Area Energia e Innovazione. 1990. 23p. (In Italian). (CONF-891261-Exc.: Lasers '89: 12th international conference on lasers and applications, New Orleans, LA (United States), 3-8 Dec 1989). Order Number DE92705827. Source: OSTI; NTIS (US Sales Only).

Individual contributions are indexed.

**34843** (ENEA-RT-INN-90-02, pp. 5-12) **Three dimensional FEL theory.** Dattoli, G.; Fang, H.; Torre, A.; Caloi, R. ENEA, Frascati (Italy). Dipt. Tecnologie Intersettoriali di Base. 1990. (CONF-891261-: Lasers '89: 12th international conference on lasers and applications, New Orleans, LA (United States), 3-8 Dec 1989). In *Contributions to international conference on laser '89.* 23p. Order Number DE92705827. Source: OSTI; NTIS (US Sales Only).

From International conference on laser '89; New Orleans, USA (3-8 Dec 1989).

This note illustrates a possible method for analyzing transverse mode dynamics in a free electron laser (FEL) operating with an electron beam which is longitudinally continuous but transversally shaped. The method consists basically of expanding the optical field in terms of Hermite-Gaussian modes, taken at the entrance to the undulator. The coefficients of that expansion are expressed in the form of a superimposition of plane-waves with complex-frequencies. What results is a set of recursive relations, partly reproducing those obtained within the context of the single-mode evolution and partly displaying the effect (revealed by a coupling among the modes) of both diffraction and interaction with the e-beam. The results presented here might represent a starting point in the analysis of the effects of the transverse structure on the FEL optical field evolution.

**34844** (ENEA-RT-INN-90-02, pp. 13-18) **X-ray triggering of ten-liter discharge excimer system.** Bollanti, S.; Di Lazzaro, P.; Flora, F.; Giordano, G.; Letardi, T.; Lisi, N.; Schina, G.; Zheng, C.E. ENEA, Frascati (Italy). Dipt. Tecnologie Intersettoriali di Base. 1990. (CONF-891261-: Lasers '89: 12th international conference on lasers and applications, New Orleans, LA (United States), 3-8 Dec 1989). In *Contributions to international conference on laser '89.* 23p. Order Number DE92705827. Source: OSTI; NTIS (US Sales Only).

From International conference on laser '89; New Orleans, USA (3-8 Dec 1989).

The switchless discharge technique was successfully applied to a 10 liter active volume XeCl laser system by using X-rays as a photoionization source. A 8 J per pulse output energy at lamba = 308 nm, uniformly distributed over a (7x10) square centimeter near-field laser spot size was achieved. The average output power was 45 W at a 6 Hz repetition rate, actual power supply limited. Both the 8 J output energy and the 0.74% plug efficiency obtained compare very well with the performance achieved in the conventional operation mode. Most important, this technique allows the operation, for the first time, of the lab's large system in the repetitive mode. This goal could not be easily attained using a single thyratron or a spark-gap as an electrical switch.

**34845** (FNAL-TM-1754) **Performance of a new monolithic eight channel charge sensitive preamplifier-shaper.** Zimmerman, T. Fermi National Accelerator Lab., Batavia, IL (United States). Aug 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE92000599. Source: OSTI; NTIS; INIS; GPO Dep.

A monolithic eight channel CMOS time-invariant preamplifier shaper has been designed and built by Chuck Britton of ORNL in collaboration with Ray Yarema and Tom Zimmerman of Fermilab. Each of the eight channels incorporates a charge sensitive preamplifier and two shaping stages. The resultant weighting function is similar to CR-RC$^3$. The peaking time is approximately 200 ns, and the charge gain approximately in the range of 50–70 mv/fc. The layout was done on a Tinychip pad frame and the device was fabricated in a 2$\mu$ P-well process by Orbit. Figure 1 shows the chip layout. The channels are on an 84$\mu$ pitch to fit on a Tinychip without folding the layout. The design can be easily expanded to a larger number of channels. This paper describes results of tests performed on this device at Fermilab. The tests were done with a bare die which was directly wirebonded to a printed circuit board. This minimizes parasitic effects which can become significant when using large packages. Results may be somewhat different when using the standard 40 pin package. 6 figs.

**34846** (KCP–613-4673) **Aqueous dryfilm photoresist for thin film network pattern gold electroplating.** Hines, R.A. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. Sep 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. (CONF-9109259–7: 1. international congress on environmentally conscious manufacturing, Santa Fe, NM (United States), 18 Sep 1991). Order Number DE92000463. Source: OSTI; NTIS; GPO Dep.

An aqueous dryfilm photoresist was evaluated and selected to replace a solvent based resist for pattern gold electroplating of thin film networks. The aqueous resist not only eliminated solvents from the process but also improved resolution, line width control, and underplating of the resist. The new resist has been used to make TFNs with narrow lines and spaces that could not be made with the old resist. The adhesion of the new resist has produced excellent results on sapphire substrates allowing a low yield TFN, made with an etchback process on evaporated gold, to be coverted to pattern electroplated gold. In contrast with prior positive dryfilm results where "snap back" caused voids around vias, via resistance has been excellent. 1 ref., 1 fig., 3 tabs.

**34847** (LA-UR–91-2833) **Virtual cathode microwave devices – Basics.** Thode, L.E.; Snell, C.M. Los Alamos National Lab., NM (United States). [1991]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109279–2: International school of plasma physics high power microwave generation and applications, Varenna (Italy), 9-17 Sep 1991). Order Number DE92000318. Source: OSTI; NTIS; GPO Dep.

Unlike a conventional microwave tube, a virtual-cathode device operates above the space-charge limit where the depth of the space-charge potential can cause electron reflection. The region associated with this electron reflection is referred to as a virtual cathode. Microwaves can be generated through oscillations in the position of the virtual cathode and through the bunching of electrons trapped in a potential well between the real and virtual cathodes. These two mechanisms are competitive. There are three basic classes of virtual cathode devices: (1) reflex triode; (2) reditron and side-shoot vircator; and (3) reflex diode or vircator. The reflex diode is the highest power virtual-cathode device. For the reflex diode the energy exchange between the beam and electromagnetic wave occurs in both the axial and radial directions. In some designs the oscillating-virtual-cathode frequency exceeds the reflexing-electron frequency exceeds the oscillating-virtual-cathode frequency. For the flex diode a periodic disruption in magnetic insulation can modulate the high- frequency microwave power. Overall, particle-in-cell simulation predictions and axial reflex diode experiments are in good agreement. Although frequency stability and phase locking of the reflex diode have been demonstrated, little progress has been made in efficiency enhancement. 58 refs., 11 figs.

**34848** (LA-UR–91-3013) **Even harmonic lasing.** Schmitt, M.J. Los Alamos National Lab., NM (United States). [1991]. 12p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9108118–3: 13. international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000207. Source: OSTI; NTIS; GPO Dep.

Operation of a free-electron laser at harmonics of the fundamental frequency is explored with the numerical simulation code HELEX. This code includes coupling to the harmonics caused by misalignment of the electrons with the optical beam and coupling due to transverse gradients. Albeit weak, the transverse gradients produce the dominant coupling of the electrons to the even-harmonic light. Even-harmonic lasing occurs in a $TEM_{0,2m+1}$-like mode where the field on axis is zero. As bunching of the electron beam progresses, radiation at the higher odd harmonics is suppressed owing to the absence of higher-order odd-harmonic Fourier components in the bunch. Growth of the even-harmonic power from small signal requires suppression of competing harmonics (including the fundamental) that have higher gain. Lasing at an even harmonic has yet to be experimentally demonstrated in an open resonator (i.e. optical cavity). Strategies to make such an experiment possible are discussed. 9 refs., 5 figs., 1 tab.

**34849** (SAND–90-3101C) **Tests on photoconductive semiconductor switches for subnanosecond risetime, multi-megavolt pulser applications.** Carboni, V.B. (Pulse Sciences, Inc., San Leandro, CA (United States)); Smith, I.D.; Pixton, R.M.; Abdalla, M.D.; Zutavern, F.J.; Loubriel, G.M.; O'Malley, M.W. Sandia National Labs., Albuquerque, NM (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Contract F29601-87-C-0201. (CONF-910640–45: 8. IEEE pulsed power conference, San Diego, CA (United States), 17-19 Jun 1991). Order Number DE91018797. Source: OSTI; NTIS; GPO Dep.

Experiments were performed to determine the applicability of photoconductive semiconductor switches (PCSS) for use as output switches in subnanosecond pulse for EMP simulators. Lateral switches made of Gallium Arsenide and Silicon with 1.5 cm long insulating regions immersed in Fluorinert were tested in a 50 ohm tri-plate transmission line geometry. Mode locked and Q-switched lasers were used to trigger both a gas switched Marx generator which pulse-charged the transmission line in 100–150 ns and to illuminate the PCSS via an optical delay line. Illuminating beam energies and electric field strengths at switchout were varied to determine minimum risetimes and light energies required for triggering. The GaAs switches were operated in the high gain (lock-on) mode. Risetimes as fast as 600 ps were observed using a mode locked laser and 700 ps using a Q-switched laser. The minimum light energy required to trigger GaAs was 22 $\mu$J and the highest switched fields for both GaAs and Si is about 60 kV/cm. 1 ref., 11 figs.

**34850** (SAND–91-0741C) **Case history: Failure analysis of a CMOS SRAM with an intermittent open contact.** Campbell, A.N.; Cole, E.I. Jr.; Henderson, C.L.; Taylor, M.R. Sandia National Labs., Albuquerque, NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911115–2: 17. international symposium for testing and failure analysis, Los Angeles, CA (United States), 11-15 Nov 1991). Order Number DE91018811. Source: OSTI; NTIS; GPO Dep.

Analysis of an intermittent failure to write the "1" state to a particular memory location at low temperature (–55°C) in a 16K × 1 CMOS SRAM is presented. The failure was found to be due to an open metallization at a metal-to-silicon contact. The root cause of the failure was poor step coverage of the metallization over an oxide step. A variety of failure analysis techniques including dynamic electron beam analysis at low temperature using a Peltier cold stage were employed to study the intermittently failing SRAM. The failure site was located by using capacitive coupling voltage contrast analysis. PSPICE simulation, light emission microscopy, scanning electron microscopy, and focused-ion beam techniques were used to confirm the failure mechanism and location. The write cycle time of the failed IC was abnormally long, but within the allowable tester limit. The vulnerability of other ICs to failure by open metallization in metal-to-silicon contacts is reviewed. 8 refs., 10 figs., 2 tabs.

**34851** (SAND–91-1726C) **The behavior and testing implications of CMOS IC logic gate open circuits.** Henderson, C.L.

(Sandia National Labs., Albuquerque, NM (United States)); Soden, J.M.; Hawkins, C.F. Sandia National Labs., Albuquerque, NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9110211–1: 1991 international test conference, Nashville, TN (United States), 28 Oct - 1 nov 1991). Order Number DE91018679. Source: OSTI; NTIS; GPO Dep.

The electrical and test properties of several logic gate open circuit defect structures were measured. Results indicate that tunneling current across fine geometry discontinuities enables low frequency operation of Integrated Circuits (ICs). No significant capacitive coupling was observed for adjacent metal interconnect or for large metal opens on the gate interconnects. These results indicate the need for different methods of open circuit defect detection during test. 14 refs., 12 figs.

**34852** (SAND–91-1953C) **Hole and electron trapping in irradiated MOS devices.** Fleetwood, D.M.; Reber, R.A. Jr.; Winokur, P.S. Sandia National Labs., Albuquerque, NM (United States). [1991]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911253–1: Semiconductor interface specialists conference, Orlando, FL (United States), 11-14 Dec 1991). Order Number DE91018685. Source: OSTI; NTIS; GPO Dep.

Short communication. MOS TRANSISTORS/physical radiation effects; HOLES; SILICON; SILICON OXIDES; INTERFACES; THERMOELECTRICITY; TRAPPING

**34853** (SAND–91-2078C) **Fatigue life prediction of solder joints.** Jones, W.B. Sandia National Labs., Albuquerque, NM (United States). 10 Sep 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911003–16: Fall meeting of the Minerals, Metals and Materials Society of AIME and Materials Week of the American Society of Metals, Cincinnati, OH (United States), 20-24 Oct 1991). Order Number DE91019058. Source: OSTI; NTIS; GPO Dep.

The current status of lifetime prediction under conditions of thermomechanical creep/fatigue is reviewed. Each method is summarized and the results of the application to solder joints is shown. While each method has been applied with some success, a predictive, phenomenological approach has not been developed and validated. A method which captures the response of a crack to steady-state and cycling environments appears to hold most the most promise to provide a useful design tool. 42 refs., 14 figs., 1 tab.

**34854** (SAND–91-2850C) **An astigmatic unstable resonator with an intracavity deformable mirror.** Neal, D.R. (Sandia National Labs., Albuquerque, NM (United States)); McMillin, P.L.; Michie, R.B. Sandia National Labs., Albuquerque, NM (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9107115–50: Society of Photo-Optical Instrumentation Engineers (SPIE) meeting, San Diego, CA (United States), 21-26 Jul 1991). Order Number DE91018815. Source: OSTI; NTIS; GPO Dep.

Many side-pumped lasers exhibit significant index gradients across the gain region aperture. For pulsed lasers where these gradients are time dependent, extraction with good beam quality requires the use of an adaptive optic. Since these inhomogeneities are systematic, wavefront correction can be performed with a model deformable mirror. We have designed a resonator which uses a cylindrically deformable mirror to correct for wavefront aberrations in a pulsed nuclear-reactor-driven laser. The mirror is capable of correcting up to ten waves of cylindrical focus error while maintaining tip/tilt alignment of the resonator. It is based around the flat plate bending using magnetostrictive actuators. A cylindrical intracavity beam expander is used to image the DM into the laser gain region. The beam expander can be adjusted to vary the resonator magnification in one axis, or to control the stability of the resonator. The mirror is controlled closed loop using a four channel wavefront sensor and a digital control system. 16 refs., 14 figs.

**34855** (UCRL–21217) **Lawrence Livermore National Laboratory Underwater Laser Imaging System (UWLIS) development project: Tank test 2 results.** Kulp, T.J.; Garvis, D.; Kennedy, R. Lawrence Livermore National Lab., CA (United States). [1991]. 31p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91019001. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report provides a summary of the second in-water test of the LLNL/NAVSEA Underwater Laser Imaging System (UWLIS). The UWLIS is a laser-based, synchronous-scanning, underwater imaging device that is designed to operate at greater ranges than is possible with conventional underwater TV cameras. It differs from earlier prototype synchronous-scanning systems in that it is capable of producing real-time, RS-170 video images. It is being developed for eventual use on Remotely Operated Vehicles (ROVs) during deep-ocean Naval salvage missions. The floodlight-illuminated television cameras presently used on NAVSEA vessels can produce images at ranges up to about 2 attenuation lengths (An attenuation length is the distance light must travel to be reduced to 1/e of its original intensity. It is typically 20 to 30 m in clear water). Beyond that point, backscattered illumination (common-volume backscatter) from particles in the intervening seawater between the imager and the target overwhelms the return signal, and the image is lost. The special optical geometry of the synchronous-scanning imager is designed to minimize common-volume effects. Previous theoretical studies indicate that a system of this type should be capable of operation at distances as great as 6 to 7 attenuation lengths. An improvement of this magnitude would greatly increase the efficiency of salvage operations, thus decreasing their cost. 5 refs., 7 figs., 4 tabs.

**34856** (UCRL-TT–105456) **Method for increasing efficiency of copper vapor limit.** Ouchi, Kazumi (Tokai Inst., Nuclear Reactor/Nuclear Fuel Development Foundation, Tokaimura, Naka-gun, Ibaraki-ken (Japan)). Lawrence Livermore National Lab., CA (United States). 12 Nov 1990. 8p. Translation of Japanese Kokai Patent No. Hei 2[1990]-2826. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91017786. Source: OSTI; NTIS; GPO Dep.

According to the method for increasing the efficiency of a copper vapor in this invention, energy transfer due to collision between cadmium atoms and copper atoms takes place, enabling pumping of copper atoms from the ground state, pumping from the lower laser level, and depletion of the lower laser level to prolong the inverted population. In this way, the optical pulse oscillation time (pulse width) can be prolonged and the efficiency of the copper vapor laser can be increased. As this type of copper vapor laser is used in the laser uranium enriching apparatus, the enrichment efficiency can be increased. As a result, it makes a large contribution to the industry.

# 43 PARTICLE ACCELERATORS

*Refer also to citation(s) 35500*

## 4301 Design, Development, and Operation

*Refer also to citation(s) 35105, 35460*

**34857** (CONF-9106107–3) **Proposal of physics with exotic beams at Oak Ridge.** Lee, I-Yang. Oak Ridge National Lab., TN (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International conference on new nuclear physics with advanced techniques; Ierapetra (Greece); 23-29 Jun 1991. Order Number DE92000743. Source: OSTI; NTIS; INIS; GPO Dep.

A facility to produce proton-rich radioactive beams for nuclear structure and astrophysics experiments is proposed. This Oak Ridge Exotic Beam (OREB) facility is based on two existing accelerators. Beams of mass up to 80 can be accelerated to energies of about 5 MeV/nucleon. It will provide opportunities to study new areas in nuclear physics and astrophysics that are not available with the use of stable beams. 3 figs.

**34858** (DOE/ER/40465–T2) **Proposed research on advanced accelerator concepts: Final report, June 1, 1988–May 31, 1991.** Davidson, R.C.; Wurtele, J.S. Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center. Sep

1991. 11p. Sponsored by USDOE. Washington, DC (United States). DOE Contract FG02-88ER40465. Order Number DE92000824. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes technical progress and accomplishments during the proposed three-year research on advanced accelerator concepts supported by the Department of Energy under Contract No. DE-FG02-88ER40465. A vigorous theoretical program has been pursued in critical problem areas related to advanced accelerator concepts and the basic equilibrium, stability, and radiation properties of intense charged particle beams. Broadly speaking, our research has made significant contributions in the following three major areas: Investigations of physics issues related to particle acceleration including two-beam accelerators and cyclotron resonance laser (CRL) accelerators: Investigations of RF sources including the free- electron lasers, cyclotron resonance masers, and relativistic magnetrons: Studies of coherent structures in electron plasmas and beams ranging from a low-density, nonrelativistic, pure electron plasma column to high-density, relativistic, non-neutral electron flow in a high-voltage diode. The remainder of this report presents theoretical and computational advances in these areas.

**34859** (ENEA-RTI-INN–91-02) **Linac (10 MeV) for 100 micron FEL experiment: Feasibility study.** Raimondi, P.; Ronsivalle, C. ENEA, Casaccia (Italy). Area Energia e Innovazione. 1991. 19p. (In Italian). (RTI-INN–91-02). Order Number DE92705884. Source: OSTI; NTIS (US Sales Only).

This paper presents the planning criteria and preliminary design calculations (using the beam dynamics, RCTRAK - integrates electron motion without spatial charge, and PARMELA - includes spatial charge, codes) for a 10 MeV SW linac operating in the S band and intended for experimental use as a source for a free electron laser (FEL) operating in the far infrared range of 100 microns. A study was completed for the part relative to an injection system made up of an electron cannon, a harmonic pre-buncher, and transport channel, all optimized with the aim of obtaining the best possible outlet beam characteristics. The linac is to operate at 2998 MHz and be SW side-coupled. It is to have 16 whole cavities and an overall length of 80 cm. It is to be used with a 15 MW klystron (10 MW available/beam, 1 ampere macro-bunch current).

**34860** (KFK–4808) **General-purpose synchrotron radiation sources.** Moser, H.O. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Mikrostrukturtechnik (IMT). Dec 1990. 8p. (CONF-901116–42: 11. international conference on the application of accelerators in research and industry, Denton, TX (United States), 5-8 Nov 1990). Order Number DE92711236. Source: OSTI; NTIS (US Sales Only).

General-purpose sources of synchrotron radiation are proposed to satisfy those future needs of basic, applied, and industrial research as well as of industrial production which cannot be covered adequately by the existing machine types. Their spectrum extends into the hard X-ray range. They feature a mixed lattice composed of superconducting and normal conducting bending magnets, and dispersion-free straight sections to accommodate insertion devices. The mixed lattice offers an additional way of minimizing the emittance by optimizing the distribution of bending angle among the different types of bending magnets. At an energy of 1.5 GeV the emittance in a six-period Triple Band Achromat lattice can be brought into the $10^{-7}$-$10^{-8}$ m.rad range. (orig.).

**34861** (LA-UR–91-2797) **Accelerator technology for Los Alamos nuclear-waste-transmutation and energy-production concepts.** Lawrence, G.P.; Jameson, R.A.; Schriber, S.O. Los Alamos National Lab., NM (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910626–7: 6. international conference on emerging nuclear energy systems, Monterey, CA (United States), 16-21 Jun 1991). Order Number DE91018049. Source: OSTI; NTIS; INIS; GPO Dep.

Powerful proton linacs are being studied at Los Alamos as drivers for high-flux neutron sources that can transmute long-lived fission products and actinides in defense nuclear waste, and also as drivers of advanced fission-energy systems that could generate electric power with no long-term waste legacy. A transmuter fed by an 800-MeV, 140-mA cw conventional copper linac could destroy the accumulated $^{99}$Tc and $^{129}$I at the DOE's Hanford site within 30 years. A high-efficiency 1200-MeV, 140-mA niobium superconducting linac could drive an energy-producing system generating 1-GWe electric power. Preliminary design concepts for these different high-power linacs are discussed, along with the principal technical issues and the status of the technology base. 9 refs., 5 figs., 4 tabs.

**34862** (LA-UR–91-3091) **Physics design of the high brightness linac for the advanced free-electron laser initiative at Los Alamos.** Sheffield, R.L.; Browman, M.J.; Carlsten, B.E.; Young, L.M. Los Alamos National Lab., NM (United States). [1991]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9108118–5: 13. international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000179. Source: OSTI; NTIS; INIS; GPO Dep.

Free electron lasers and high energy physics accelerators have increased the demand for very high brightness electron beam sources. This paper describes the design of an accelerator which can produce beams of greater than $7 \times 10^{11}$ A/m$^2$ (brightness = $2^{*}1/\varepsilon^2$, with $\varepsilon$ = 90% normalized emittance = 4° rms emittance). The beam emittance growth in the accelerator is minimized by the following: producing a short electron bunch in a high gradient rf cavity, using a focusing solenoid to correct the emittance growth due to space charge, and designing the coupling slots between accelerator cavities to minimize quadruple effects. The simulation code PARMELA was modified for this design effort. This modified version uses SUPERFISH output files for the accelerator cavity field, MAFIA output files for the 3-D perturbation fields due to the coupling slots in the accelerator cells, and POISSON output files for the solenoid field in the gun region. The results from simulations are, at 2.3 nC, a peak current of 180 A and a 90% emittance of 9.4 $\pi$ mm-mmrad. The exit energy from the linac is 20 MeV for both cases. A magnetic pulse compressor can be used to further increase the peak current. 8 refs., 10 figs.

**34863** (LBL–27437) **The Advanced Light Source: A new 1.5 GeV synchrotron radiation facility at the Lawrence Berkeley Laboratory.** Schlachter, A.S. Lawrence Berkeley Lab., CA (United States). 30 Jun 1989. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-8905210–4: International conference on synchrotron radiation application, Hefei (China), 9-12 May 1989). Order Number DE92000863. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Light Source (ALS), now under construction at the Lawrence Berkeley Laboratory, is being planned as a national user facility for the production of high-brightness and partially coherent x-ray and ultraviolet synchrotron radiation. The ALS is based on a low-emittance electron storage ring optimized for operation at 1.5 GeV with insertion devices in 11 long straight sections and up to 48 bend-magnet ports. High-brightness photon beams, from less than 10 eV to more than 1 keV, will be produced by undulators, thereby providing many research opportunities in materials and surface science, biology, atomic physics and chemistry. Wigglers and bend magnets will provide high-flux, broad-band radiation at energies to 10 keV. 6 refs., 10 figs., 2 tabs.

**34864** (LBL–29243) **Radioactive ion beams at the Bevalac: Greatly enhanced fragment separation for high energy beams.** Feinberg, B.; Kalnins, J.G.; Krebs, G.F. Lawrence Berkeley Lab., CA (United States). Sep 1990. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000653. Source: OSTI; NTIS; INIS; GPO Dep.

Radioactive beams are routinely produced at the Bevalac by the fragmentation process. High energy beams (energies ~ 800 MeV/u) produce fragments with nearly the original beam momentum, forming a radioactive ion beam. A new beamline is being constructed which will provide resolution for ions approaching the mass 100 region, compared to the present mass 20 capability, by strongly increasing the dispersion and also increasing the beam size for easier tuning and more effective collimation. In addition, the angular acceptance has been more than doubled. Details of the design will be presented. 6 refs., 4 figs., 1 tab.

**34865** (LBL–29947) **The Advanced Light Source: Status report.** Jackson, A. Lawrence Berkeley Lab., CA (United States).

May 1991. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-910505–409: 1991 Institute of Electrical and Electronics Engineers (IEEE) particle accelerator conference (PAC), San Francisco, CA (United States), 6-9 May 1991). Order Number DE92000922. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Light Source (ALS), a national user facility currently under construction at the Lawrence Berkeley Laboratory (LBL), is a third-generation synchrotron light source designed to produce extremely bright beams of synchrotron radiation in the energy range from a few eV to 10 keV. The design is based on a 1–1.9-GeV electron storage ring (optimized at 1.5 GeV), and utilizes special magnets, known as undulators and wigglers (collectively referred to as insertion devices), to generate the radiation. The facility is scheduled to begin operating in April 1993. In this paper we describe the progress in the design, construction, and commissioning of the accelerator systems, insertion devices, and beamlines. Companion presentations at this conference give more detail of specific components in the ALS, and describe the activities towards establishing an exciting user program. 3 figs., 2 tabs.

**34866** (NIFS-PROC–5, pp. 59-67) **Pulse-power characteristic of 'VIVA-I', Versatile Inductive Voltage Adder.** Shimiya, K. (Nagaoka Univ. of Technology, Niigata (Japan)); Hozumi, Y.; Aoyama, T.; Sekimoto, Y.; Masugata, K.; Yatsui, K.; Shigeta, M.; Shibata, K. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185–: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications*. 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

Versatile Inductive Voltage Adder, 'VIVA-I', with high potential gradient has been successfully developed to be in operation. It has been designed to produce output pulse of 4 MV, 60 ns by adding 2 MV pulses in 2-stages of induction cells, where amorphous cores are installed. Within ~ 40 % of full charge voltage, pulse-power characteristics of Marx generator, pulse forming line (PFL), transmission line (TL), and induction cells were tested for three types of loads; open-circuit, dummy-load of $CuSO_4$ resistor, and electron diode. In open-circuit test, ~ 2.0 MV of output voltage was obtained with good reproducibility. Dependence of output voltage on diode impedance was evaluated by using a dummy-load, and good agreement was obtained with that expected. An E-beam diode was operated successfully, and ~ 18 kA of beam current was obtained at diode voltage of ~ 1 MV. (author).

**34867** (SAND–91-1975C) **RADLAC 2 performance summary.** Shope, S.L. (Sandia National Labs., Albuquerque, NM (United States)); Mazarakis, M.G.; Frost, C.A.; Crist, C.E.; Poukey, J.W.; Prestwich, K.R.; Turman, B.N.; Struve, K.; Welch, D. Sandia National Labs., Albuquerque, NM (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). (CONF-9107177–1: 1991 annual charged particle beam review, Beltsville, MD (United States), 25-29 Jul 1991). Order Number DE91018812. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A 12.5-m long Self Magnetically Insulated Transmission LinE (SMILE) that sums the voltages of eight, 2-MV pulse forming lines was installed in the RADLAC-2 linear introduction accelerator. The magnetic insulation criteria were calculated using parapotential flow theory and found to agree with MAGIC simulations. High quality annular beams with a transverse velocity $\beta\perp = v\perp/c \leq 0.1$ and a radius $r_b < 2$ cm were measured for currents of 50 to 100 kA extracted from a magnetic immersed foilless diode. These parameters were achieved with 11 to 15-MV accelerating voltages and 6 to 16-kG diode magnetic fields. The experimental results exceeded our design expectations and are in good agreement with code simulations. 2 refs., 6 figs., 2 tabs.

**34868** (SLAC-PUB–5651) **Towards the next linear collider.** Irwin, J. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-910881–8: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000237. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses design choices for the next generation linear colliders. (LSP)

**34869** (SSCL–396) **Application of system safety engineering techniques for hazard prevention at the Superconducting Super Collider.** Hendrix, B.L. Superconducting Super Collider Lab., Dallas, TX (United States). Mar 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-910340–49: 3. annual international industrial symposium on the super collider (IISSC), Atlanta, GA (United States), 13-15 Mar 1991). Order Number DE91018733. Source: OSTI; NTIS; INIS; GPO Dep.

A primary goal of the Superconducting Super Collider Laboratory (SSCL) is to establish an exemplary safety program. Achieving this goal requires leadership, planning, coordination, and technical know-how. To ensure that safety is an inherent part of the design, the Environment, Safety and Health Office employs a systems engineering discipline and process known as System Safety. The goal of System Safety – hazard prevention – is accomplished by analyzing systems to identify hazards and to evaluate design and procedural options and countermeasures to prevent, eliminate, mitigate, or control hazards and risks. Establishment of safety and human factors design criteria at the outset of the project prevents unsafe designs and safety violations, reduces risks, and helps in avoiding costly design changes later. This process requires a considerable amount of coordination with a variety of technical disciplines and safety professionals to integrate methods of hazard prevention, mitigation, and risk reduction throughout the system life-cycle.

## 4302 Beam Dynamics, Field Calculations, and Ion Optics

*Refer also to citation(s) 34859, 35460*

**34870** (ANL/CP–72543) **Effect of magnet misalignment on neutral beam aberration coefficients.** Micklich, B.J.; Curry, B.P.; Yule, T.J. Argonne National Lab., IL (United States). [1991]. 8p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9104286–3: Neutral particle beam technical symposium, Boulder, CO (United States), 15-19 Apr 1991). Order Number DE91018593. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The quality of a neutral particle beam is sensitive to misalignment of the magnets which constitute the beamline. In addition to static misalignment, neutral particle beam experiments in space will be subject to dynamic misalignment effects as a consequence of structural vibrations. In order to obtain data to benchmark codes which can later be used to estimate the severity of similar effects in space experiments, a series of experiments was carried out at the Argonne National Laboratory Neutral Particle Beam Test Stand (NPBTS). The effects of some types of magnet misalignments were simulated by deliberately misaligning the beam using small steering magnets placed at several locations in the NPBTS beamline. Experiments involved angular misalignments of the beam forward of the eyepiece of the LANL/LBL Telescope and a lateral offset of the beam from the magnetic axis between the eyepiece and objective of the telescope. Aberration measurements were made using the ANL Pinhole Diagnostic System, with the aberration correctors turned off and without using the large steering magnets downstream of the telescope. Changes in the measured aberration coefficients from the nominal condition are presented relative to the standard deviations of the coefficients for an unsteered beam. These data will be analyzed in the future using beam dynamics codes adapted for the purpose. 2 refs., 5 figs., 2 tabs.

**34871** (BNL–46582) **Reduction of FEL gain due to wiggler errors.** Yu, L.H. (Brookhaven National Lab., Upton, NY (United States)); Krinsky, S.; Friedman, A.; Gluckstern, R.L.; van Zeijts, J.B.J. Brookhaven National Lab., Upton, NY (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9108118–7: 13. international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000482. Source: OSTI; NTIS; INIS; GPO Dep.

For an FEL operating in the exponential regime before saturation, we consider the effect on the gain of longitudinal velocity variations arising from wiggler field errors. The average gain reduction and the width of the output power distribution are expressed in terms of the mean square average of the ponderomotive phase shift per gain length. A scheme for correcting the electron trajectory using position monitors and dipole correctors is analyzed. Analytic results are compared with numerical simulations. Our work is directly applicable to the design of FEL amplifiers and the results are encouraging for the feasibility of such devices. 13 refs., 2 figs.

**34872** (BNL–46608) **The effect of wiggler errors on FEL gain.** Yu, L.H. (Brookhaven National Lab., Upton, NY (United States)); Krinsky, S.; Gluckstern, R.L.; van Zeijts, J.B.J. Brookhaven National Lab., Upton, NY (United States). [1991]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9108118–8: 13. international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000483. Source: OSTI; NTIS; INIS; GPO Dep.

For an FEL operating in the exponential regime before saturation, we present an analytic description of the effect on the gain of longitudinal velocity variations arising from wiggler field errors. The average gain reduction and the width of the output power distribution are expressed in terms of the mean square average of the ponderomotive phase shift per gain length. A scheme for correcting the electron trajectory using position monitors and dipole correctors is analyzed. Our work is directly applicable to the design of FEL amplifiers and the results are encouraging for their feasibility. 13 refs., 3 figs.

**34873** (CEA-LNS-GT–91-05) **A numerical method for combined spin tracking and raytracing of charged particles.** Meot, F. Laboratoire National Saturne - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). 1991. 19p. Order Number DE92707140. Source: OSTI; NTIS (US Sales Only).

A numerical method for the resolution of the differential equation that governs the spin motion of a particle in a magnetic field is presented. This method has been straighforwardly implemented in the raytracing program Zgoubi which solves in a similar way the equation of motion of the particle. Examples are given: a comparison with analytical calculations by S. Nurushev; the calculation of spin transfer matrices of some classical optical elements; the depolarization in the QDD spectrometer SPES 2 of Saclay, and finally a study of the depolarization near the resonance $\gamma G = \nu_z$ in the synchrotron Saturne 2.

**34874** (KEK–90-21) **Fourth advanced ICFA beam dynamics workshop on collective effects in short bunches.** Hirata, K.; Suzuki, T. (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Feb 1991. 202p. (CONF-9009292–: 4. advanced ICFA beam dynamics workshop on collective effects in short bunches, Tokyo (Japan), 22-29 Sep 1990). Order Number DE92713858. Source: OSTI; NTIS (US Sales Only); INIS.

This issue is the collection of the papers presented at the title meeting. The 18 of the presented papers are indexed individually. (J.P.N.).

**34875** (KEK–91-1) **Design and performance of beamline 7C at the Photon Factory.** Nomura, Masaharu; Koyama, Atsushi; Sakurai, Masaki. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Apr 1991. 32p. Order Number DE92713932. Source: OSTI; NTIS (US Sales Only); INIS.

Design and characterization of beamline 7C at the Photon Factory (PF) is described. The beamline is designed to obtain clear intense monochromatic beam at rather low energy region by using a sagittal focusing double crystal monochromator and a focusing double mirror system: the photon flux is $10^{11} s^{-1}$ and the ratio of higher order is approx. $10^{-5}$ compared with the fundamental beam. Performance of the monochromator is discussed in detail. Fluorescent XAFS of 0.2mmol/l copper solution is shown to demonstrate the performance of this beamline. (author).

**34876** (LBL–29810) **Three-dimensional magnetic field produced by an axisymmetric iron yoke.** Laslett, L.J.; Caspi, S.; Helm, M.; Brady, V. Lawrence Berkeley Lab., CA (United States). Jun 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (SC-MAG–315;CONF-910662–4: 12. international conference on magnet technology, Leningrad (USSR), 23-28 Jun 1991). Order Number DE92000867. Source: OSTI; NTIS; INIS; GPO Dep.

A computational procedure, in which separate analyses are performed for conductor and high permeability iron yoke, has been developed for calculating the three-dimensional magnetic field components. Whereas the field components of the isolated 3-D current array can be evaluated at all desired points through the use of a 3-D Biot-Savart law program, we have developed a method for calculating the supplemental field that will arise as a result of the presence of a surrounding high-permeability magnetic yoke with an axially-symmetric bore. We may speak of this supplemental field as an "image field" although we shall realize that is may be possible in general to attribute it only to a distinctly diffuse distribution of "image current" or magnetic moments. The boundary associated with the "image field" is such that at each point along the boundary of the high permeability iron the total scalar potential shall be constant, e.g. $V^i = -V^d$ (where i=image and d=direct). When we describe both potentials as a series of "harmonic components" then the nature of the boundary condition is such that a de-coupling of one harmonic from another is preserved, and therefore it is also true that $V^i(n) = -V^d(n)$ at the iron interface, where n is a harmonic number. When we solve the appropriate differential equations for these scalar potential functions throughout the iron-free region with the proper applied boundary condition for the scalar potential of each harmonic number, we achieve upon summation the appropriate field contribution of the surrounding high-permeability iron.

**34877** (LBL–29819) **Magnetic field in the end region of the SSC quadrupole magnet.** Caspi, S.; Helm, M.; Laslett, L.J. Lawrence Berkeley Lab., CA (United States). Jun 1991. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (SC-MAG–316;CONF-910662–3: 12. international conference on magnet technology, Leningrad (USSR), 23-28 Jun 1991). Order Number DE92000850. Source: OSTI; NTIS; INIS; GPO Dep.

Recent advances in methods of computing magnetic fields have made it possible to study the field in the end region of the SS quadrupole magnet in detail. The placement of conductor in the straight section, away from the ends, was designed to produce a practically pure quadrupole field in the two-dimensional sense. The ends of the coils were designed to produce a practically pure quadrupole field in the integral sense using a method that ignores the presence of the iron yoke. Subsequently, the effect of presence of the yoke on the field was analyzed. The paper presents the end configuration together with the computed integrated multipole components, local multipole components, and local field components. A comparison with measurements is included. 5 refs., 5 figs., 1 tab.

**34878** (LBL–29826) **The use of a relaxation method to calculate the 3D magnetic field contribution of an iron yoke.** Caspi, S.; Helm, M.; Laslett, L.J. Lawrence Berkeley Lab., CA (United States). Jul 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (SC-MAG–317;CONF-910762–1: 8. conference on the computation of electromagnetic fields, Sorrento (Italy), 7-11 Jul 1991). Order Number DE92000860. Source: OSTI; NTIS; INIS; GPO Dep.

A computational procedure has been developed for calculating the three-dimensional field produced by an axisymmetric iron yoke of high permeability in the presence of a system of conductors. The procedure is particularly applicable to the end regions of multipole magnets of the sort used in particle accelerators. The field produced by the conductors is calculated using the Biot-Savart law. We speak of the field contribution of the yoke as an "image field" although it is associated with a distinctly diffuse distribution of image currents or magnetic moments. At every point on the boundary of the yoke the total scalar potential is constant, so $V^i = -V^d$ where i=image and d=direct contribution from the conductors. If we describe both potentials as a series of "harmonic components" with respect to azimuthal dependence, then the nature of the boundary condition is such that a de-coupling of one harmonic component from another is preserved and therefore it is also true that $V^i(n) = -V^d(n)$ at the iron interface, where n is a harmonic number. If we

solve the appropriate individual differential equations for the scalar potential functions V'(n) throughout the iron-free region, with the proper applied boundary condition for the scalar potential of each harmonic number, we shall achieve upon summation the appropriate potential function to describe the field contribution of the surrounding high-permeability iron. 2 refs., 3 figs.

**34879** (LBL–30313) **3D field harmonics.** Caspi, S.; Helm, M.; Laslett, L.J. Lawrence Berkeley Lab., CA (United States). 30 Mar 1991. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (SC-MAG–328). Order Number DE92000657. Source: OSTI; NTIS; INIS: GPO Dep.

We have developed an harmonic representation for the three dimensional field components within the windings of accelerator magnets. The form by which the field is presented is suitable for interfacing with other codes that make use of the 3D field components (particle tracking and stability). The field components can be calculated with high precision and reduced cup time at any location (r,$\theta$,z) inside the magnet bore. The same conductor geometry which is used to simulate line currents is also used in CAD with modifications more readily available. It is our hope that the format used here for magnetic fields can be used not only as a means of delivering fields but also as a way by which beam dynamics can suggest correction to the conductor geometry. 5 refs., 70 figs.

**34880** (LBL–30766) **An update on passive correctors for the SSC dipole magnets.** Green, M.A. Lawrence Berkeley Lab., CA (United States). May 1991. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (SC-MAG–337). Order Number DE92000649. Source: OSTI; NTIS; INIS; GPO Dep.

The concept of correction of the magnetization sextupole became a topic of discussion as soon as it was realized that superconductor magnetization could have a serious effect on the SSC beam during injection. Several methods of correction were proposed. These included (1) correction with active bore tube windings like those on the HERA machine which correct out magnetization sextupole and the sextupole due to iron saturation, (2) correction with persistent sextupole windings mounted on the bore tube (3) correction using passive superconductor (4) correction using ferromagnetic material, and (5) correction using oriented magnetized materials. This report deals with the use of passive superconductor to correct the magnetization sextupole. Two basic methods are explored in this report: (1) One can correct the magnetization sextupole by changing the diameter of the superconductor filaments in one or more blocks of the SSC dipole. (2) One can correct the magnetization sextupole and decapole by mounting passive superconducting wires on the inside of the SSC dipole coil bore. In addition, an assessment of the contribution of each conductor in the dipole to the magnetization sextupole and decapole is shown. 38 refs, 25 figs., 15 tabs.

**34881** (LBL–31198) **Free-electron laser generation of VUV and x-ray radiation using a conditioned beam and ion-channel focusing.** Yu, Li-Hua (Brookhaven National Lab., Upton, NY (United States)); Sessler, A.; Whittum, D.H. Lawrence Berkeley Lab., CA (United States). 30 Aug 1991. 15p. Sponsored by USDOE, Washington, DC (United States); Japan Society for the Promotion of Science, Tokyo (Japan); National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). DOE Contract AC03-76SF00098 ;AC02-76CH00016. (CONF-9108118–12: 13. international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000957. Source: OSTI; NTIS; INIS; GPO Dep.

The use of ion-focusing and a conditioned beam greatly enhances FEL gain in the VUV and Soft X-Ray range. The equations governing FEL amplification are derived and results of a linear analysis are noted. Numerical results, including 3D effects and having an order of magnitude improvement in gain, are presented for a 30 Å example. 3 refs., 2 figs., 1 tab.

**34882** (SSCL–500) **Applications of differential algebra to single-particle dynamics in storage rings.** Yan, Y. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1991. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE92001607. Source: OSTI; NTIS; INIS; GPO Dep.

Recent developments in the use of differential algebra to study single-particle beam dynamics in charged-particle storage rings are the subject of this paper. Chapter 2 gives a brief review of storage rings. The concepts of betatron motion and synchrotron motion, and their associated resonances, are introduced. Also introduced are the concepts of imperfections, such as off-momentum, misalignment, and random and systematic errors, and their associated corrections. The chapter concludes with a discussion of numerical simulation principles and the concept of one-turn periodic maps. In Chapter 3, the discussion becomes more focused with the introduction of differential algebras. The most critical test for differential algebraic mapping techniques – their application to long-term stability studies – is discussed in Chapter 4. Chapter 5 presents a discussion of differential algebraic treatment of dispersed betatron motion. The paper concludes in Chapter 6 with a discussion of parameterization of high-order maps.

**34883** (SSCL–507) **First order tune shift calculations for transverse betatron dynamics.** Garavaglia, T. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1991. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-9110225–1: 1991 symposium on the Superconducting Super Collider (SSC), Corpus Christi, TX (United States), 13-17 Oct 1991). Order Number DE92000370. Source: OSTI; NTIS; INIS; GPO Dep.

An effective Hamiltonian, with non-linear magnetic multipole terms and momentum dispersion contributions, is used to obtain the first order tune-shift results for transverse betatron motion for protons in the Superconducting Super Collider (SSC). This Hamiltonian is represented in terms of action angle variables, and analytical results are obtained using symbolic algebra methods. Mathematical derivations of the transverse multipole expansion and of the transverse betatron equations, using an invariant action and curvilinear coordinates, are given in the appendices. Numerical and graphical tune-space results are given that illustrate the dependence of tune-shifts on injection amplitude and momentum spread. 10 refs., 7 figs.

## 4303 Auxiliaries and Components

*Refer also to citation(s) 34859, 34870, 34876, 34877, 34880, 34923, 34942, 35100, 35199, 35277, 35314*

**34884** (BNL–45726) **Construction and results of the 50 mm short R&D dipole magnets.** Morgan, G.H. (Brookhaven National Lab., Upton, NY (United States)); Anerella, M.; Cottingham, J.; Ganetis, G.; Garber, M.; Ghosh, A.; Greene, A.; Gupta, R.; Herrera, J.; Kahn, S.; Kelly, E.; Morgillo, A.; Muratore, J.; Prodell, A.; Rehak, M.; Rohrer, E.P.;Brookhaven National Lab., Upton, NY (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-910505–406: 1991 Institute of Electrical and Electronics Engineers (IEEE) particle accelerator conference (PAC), San Francisco, CA (United States), 6-9 May 1991). Order Number DE92000129. Source: OSTI; NTIS; INIS; GPO Dep.

The first at Brookhaven National Laboratory (BNL) of the large bore, 1.8 m SSC dipoles have been built and tested. The 2-D design of the coil, using the new, wider cables and the iron cross section are reviewed and the coil ends are described. Results from tests, including quench performance, magnetic field measurements and strain-gauge data are presented. 5 refs., 4 figs., 1 tab.

**34885** (BNL–45727) **A computer program for the 2-D magnetostatic problem based on integral equations for the field of the conductors and boundary elements.** Morgan, G.H. Brookhaven National Lab., Upton, NY (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-910662–2: 12. international conference on magnet technology, Leningrad (USSR), 23-28 Jun 1991). Order Number DE92000130. Source: OSTI; NTIS; INIS; GPO Dep.

The iterative design of the 2-dimensional cross section of a beam transport magnet having infinitely permeable iron boundaries requires a fast means of computing the field of the conductors. Solutions in the form of series expansions are used for rectangular

iron boundaries, and programs based on the method of images are used to simulate circular iron boundaries. A single procedure or program for dealing with an arbitrary iron boundary would be useful. The present program has been tested with rectangular and circular iron boundaries and provision has been made for the use of other curves. It uses complex contour integral equations for the field of the constant-current density conductors and complex line integrals for the field of the piecewise-linear boundary elements. 2 refs., 4 figs., 1 tab.

**34886** (BNL–45962) **The new BNL polarized negative ion source.** Hershcovitch, A.I.; Alessi, J.G.; DeVito, B.; Kponou, A.E. Brookhaven National Lab., Upton, NY (United States). 28 Aug 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-910943–2: 4. international conference on ion sources, Bensheim (Germany), 30 Sep - 4 oct 1991). Order Number DE92000134. Source: OSTI; NTIS; INIS; GPO Dep.

A new ground state source of negative hydrogen ions with polarized nuclei ($\vec{H}^-$) is being developed at BNL. Extensive developmental research has been aimed at improving each element of ($\vec{H}^-$) production: cold H° beam, spin selection and focusing magnets, and ionizer. These elements have recently been integrated into a source. A first test with the accommodator nozzle cooled only to liquid nitrogen temperatures resulted in 5 $\mu$A of $H^-$. Tests at liquid helium temperatures are now beginning. 7 refs., 1 fig.

**34887** (BNL–46592) **Infrared synchrotron radiation instrumentation and applications.** Williams, G.P. Brookhaven National Lab., Upton, NY (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-910730–14: 4. international conference on synchrotron radiation instrumentation, Chester (United Kingdom), 15-19 Jul 1991). Order Number DE92000474. Source: OSTI; NTIS; INIS; GPO Dep.

Infrared synchrotron radiation (IRSR) in the wavelength range from 1$\mu$m to ~1cm has now been used quite extensively both in Japan at UVSOR, Okasaki and in the United States at the NSLS, Brookhaven. The use of IRSR poses many new challenges, none the least of which is the fact that the radiation covers four decades of energy and is also very divergent and subject to diffraction. However the advantages are particularly significant due to the 1000 fold increase in brightness available over conventional sources in a region where detectors become a limiting factor. In addition, IRSR is also highly spatially coherent allowing the possibility of a new class of interferometers based on wavefront division. We will discuss this and other instrument issues as they critically relate to experiments. The applications discussed will be in the areas of surface vibrational spectroscopy, both in ultra-high vacuum and in electro-chemical cells, and in areas which use the pulsed nature of the source both for fast response studies and for pump-probe studies. 8 refs., 8 figs.

**34888** (DOE/ER/40613–1) **New technology for linear colliders: Progress report, 1991.** McIntyre, P.M. Texas A and M Univ., College Station, TX (United States). Dept. of Physics. Aug 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER40613. Order Number DE92000081. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this contract is to develop and evaluate new technology for future $e^+e^-$ linac colliders. TeV linac colliders will require major improvements in the performance of microwave power tubes: >100 mW/m peak power, ~20 GHz frequency, and high frequency. For the past three years we have been developing gigatron, a new design concept for microwave power tubes. It incorporates three key innovations: a gated field-emitter cathode which produces a fully modulated electron beam directly into the vacuum; a ribbon beam geometry which eliminates space charge and phase dispersion, and a traveling wave coupler which provides optimum output coupling even over a wide ribbon beam. During the past year we have built prototypes of two cathode designs: a stripline edge-emitter array and a porous silicon dioxide cathode. A highlight of our results is the development and testing of the porous $SiO_2$ cathode. It delivers exceptional performance as a modulated electron source in general and for gigatron in particular. Its high emitter density and low work function accommodate higher tube gain, simpler cathode coupling, and higher peak power than any other technology. The protection of the active emitting surface by ~2 $\mu$m of porous $SiO_2$ should provide for rugged operation in a tube environment.

**34889** (INS–875) **Acceleration tests of the INS 25.5-MHz split coaxial RFQ.** Arai, S.; Imanishi, A.; Morimoto, T.; Tojyo, E.; Tokuda, N.; Shibuya, S. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. May 1991. 4p. Order Number DE92704118. Source: OSTI; NTIS (US Sales Only); INIS.

The INS 25.5-MHz split coaxial RFQ, a linac that accelerates ions with a charge-to-mass ratio greater than 1/30 from 1 to 45.4 keV/u, is now undergoing acceleration tests with a beam of molecular nitrogen ($N_2^+$) ions. Results so far obtained show that the RFQ operates in accordance with the design. Presented are preliminary results on the beam performance: emittances of the in- and output beams, output energy and its spread, and beam transmission. (author).

**34890** (INS–880) **Measurement of the beam bunch in the 1.3-GeV electron synchrotron.** Mutou, Masayuki; Maruyama, Koichi; Fukushima, Toshitaka; Yoshida, Katsuhide; Miyahara, Yoshikazu. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jun 1991. 26p. Order Number DE92713911. Source: OSTI; NTIS (US Sales Only); INIS.

We observed the bunch structure of the circulating beam in the 1.3-GeV Electron Synchrotron (ES) for the first time. The ES operated at a repetition rate of 21 Hz and an rf frequency of 138 MHz. The bunch length variation during the rf acceleration were determined by measuring time distributions of photons produced by the synchrotron radiation. The observed lengths show a rapid decrease from 1.83 to 0.72 ns (FWHM) in the time interval of 2 - 5 ms after the start of acceleration (energy range of 0.1 - 0.25 GeV), and they are almost constant, 0.6 - 0.7 ns, by the end of acceleration (0.25 - 1.1 GeV). The behavior is reproduced well by a calculation taking into account the effects of the adiabatic damping, radiation damping, and radiation excitation. (author).

**34891** (INS–883) **ISOL based radioactive nuclear beam facilities.** Nomura, T. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jul 1991. 11p. Order Number DE92713942. Source: OSTI; NTIS (US Sales Only); INIS.

High-intensity and high-quality unstable nuclear beams can be realized by coupling an isotope separator on-line and a proper post accelerator in various primary beams. Some technical features and problems in the production of such beams are discussed. A brief description is given on 'Exotic Nuclei Arena' in Japanese Hadron Project. (author).

**34892** (JINR–13-89-847) **Noiseproof optical channel of ion source synchronization.** Romanov, Yu.I. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1989. 13p. (In Russian). Order Number DE92601344. Source: OSTI; NTIS (US Sales Only); INIS.

The existing methods of building optical channels with a high signal-industrial noise ratio are systematized in this paper. Basic requirements imposed upon the development of sudh channels for their operation on electrophysical setups are formulated. A practical scheme of a 50 m optical channel for the transmission of synchronization pulses of an ion source is presented. This channel is composed of (1)and IR-light diode operating in a forced mode, (2)optical insulators with the transfer of an input signal in an optical transmitter and an output signal in an optical receiver, (3)a supply system based on a transformer with a turn connecting two coils. 18 refs.; 6 figs.

**34893** (KEK–90-25(v.1)) **Proceedings of the eleventh meeting of the international collaboration on advanced neutron sources (ICANS-XI).** Misawa, M.; Furusaka, M.; Ikeda, H.; Watanabe, N. (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Mar 1991. 654p. (CONF-9010243–: International collaboration on advanced neutron sources (ICANS), Tsukuba (Japan), 21-26 Oct 1990). Order Number DE92713960. Source: OSTI; NTIS (US Sales Only); INIS.

This issue is the vol. 1 of the collection of the papers presented at the title meeting. The 112 (60 for vol. 1 and 52 for vol. 2) of the presented papers are indexed individually. (J.P.N.).

**34894** (KEK–90-25(v.2)) **Proceedings of the eleventh meeting of the international collaboration on advanced neutron sources (ICANS-XI).** Misawa, M.; Furusaka, M.; Ikeda, H.; Watanabe, N. (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Mar 1991. 532p. (CONF-9010243–: International collaboration on advanced neutron sources (ICANS), Tsukuba (Japan), 21-26 Oct 1990). Order Number DE92713961. Source: OSTI; NTIS (US Sales Only); INIS.

This issue is the vol. 2 of the collection of the papers presented at the title meeting. The 112 (60 for vol. 1 and 52 for vol. 2) of the presented papers are indexed individually. (J.P.N.).

**34895** (LA-UR–91-2834) **High-voltage virtual-cathode microwave simulations.** Thode, L.; Snell, C.M. Los Alamos National Lab., NM (United States). [1991]. 29p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109279–1: International school of plasma physics high power microwave generation and applications, Varenna (Italy), 9-17 Sep 1991). Order Number DE92000317. Source: OSTI; NTIS; GPO Dep.

In contrast to a conventional microwave tube, a virtual-cathode device operates above the space-charge limit where the depth of the space-charge potential is sufficiently large to cause electron reflection. The region associated with electron reflection is referred to as a virtual cathode. Microwaves can be generated through oscillations in the position of the virtual cathode and by reflexing electrons trapped in the potential well formed between the real and virtual cathodes. A virtual-cathode device based on the first mechanism is a vircator while one based on latter mechanism is a reflex diode. A large number of low-voltage virtual-cathode microwave configurations have been investigated. Initial simulations of a high-voltage virtual-cathode device using a self-consistent particle-in-cell code indicated reasonable conversion efficiency with no frequency chirping. The nonchirping character of the high-voltage virtual-cathode device lead to the interesting possibility of locking four very-high-power microwave devices together using the four transmission lines available at Aurora. Subsequently, in support of two high-voltage experiments, simulations were used to investigate the effect of field-emission threshold and velvet position on the cathode; anode and cathode shape; anode-cathode gap spacing; output waveguide radius; diode voltage; a cathode-coaxial-cavity resonator; a high-frequency ac-voltage drive; anode foil scattering and energy loss; and ion emission on the microwave frequency and power. Microwave

**34896** (LA-UR–91-3012) **High-brightness injectors for hadron colliders.** Wangler, T.P. Los Alamos National Lab., NM (United States). [1990]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-901165–2: 4. joint US-CERN school on particle accelerators: course on frontiers of particle beams: intensity limitations, Hilton Head Island, SC (United States), 7-14 Nov 1990). Order Number DE92000208. Source: OSTI; NTIS; INIS; GPO Dep.

The counterrotating beams in collider rings consist of trains of beam bunches with $N_B$ particles per bunch, spaced a distance $S_B$ apart. When the bunches collide, the interaction rate is determined by the luminosity, which is defined as the interaction rate per unit cross section. For head-on collisions between cylindrical Gaussian beams moving at speed $\beta c$, the luminosity is given by $L = N_B^2 \beta c / 4\pi\sigma^2 S_B$, where $\sigma$ is the rms beam size projected onto a transverse plane (the two transverse planes are assumed identical) at the interaction point. This beam size depends on the rms emittance of the beam and the focusing strength, which is a measure of the 2-D phase-space area in each transverse plane, and is defined in terms of the second moments of the beam distribution. Our convention is to use the rms normalized emittance, without factors of 4 or 6 that are sometimes used. The quantity $\tilde{\beta}$ is the Courant-Synder betatron amplitude function at the interaction point, a characteristic of the focusing lattice and $\gamma$ is the relativistic Lorentz factor. Achieving high luminosity at a given energy, and at practical values of $\tilde{\beta}$ and $S_B$, requires a large value for the ratio $N_B^2/\varepsilon_n$, which implies high intensity and small emittance. Thus, specification of the luminosity sets the requirements for beam intensity and emittance, and establishes the requirements on the performance of the injector to the collider ring. In general, for fixed $N_B$, the luminosity can be increased if $\varepsilon_n$ can be reduced. The minimum emittance of the collider is limited by the performance of the injector; consequently the design of the injector is of great importance for the ultimate performance of the collider.

**34897** (LA-UR–91-3092) **Rapid development of a measurement and control system for the Advanced Free-Electron Laser.** Wilson, W.L. Jr.; May, M.W.; Kozubal, A.J. Los Alamos National Lab., NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9108118–4: 13. international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000178. Source: OSTI; NTIS; GPO Dep.

The Experimental Physics and Industrial Control System (EPICS) is being used to develop a measurement and control system for the Advanced Free-Electron laser (AFEL) at the Los Alamos National Laboratory. EPICS is an integrated system of applications development tools and a distributed run time environment that supports an input-output database, a graphical operator interface, sequential control through "state" definition, data archiving, data analysis, and fault management. It is very advantageous in terms of both time and system integrity to be able to perform much of the control system development before the actual hardware for the AFEL is in place. Using the EPICS applications tools, we are developing prototype measurements and controls that can be directly transferred to the AFEL during installation and commissioning. This is possible due primarily to three aspects of EPICS. First we can easily model physical systems with the state notation language. Second, we can simulate input and output channels with "soft" database channels, which are created using the database configuration tool. Third, we can easily build and modify operator interface screens with the display editor. 8 refs., 3 figs.

**34898** (LA-UR–91-3102) **Developments and directions in 200 MHz very high power RF at LAMPF.** Cliff, R.; Bush, E.D.; DeHaven, R.A.; Harris, H.W.; Parsons, M. Los Alamos National Lab., NM (United States). [1991]. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9110221–1: RF Expo '91, Orlando, FL (United States), 29 Oct 1991). Order Number DE92000175. Source: OSTI; NTIS; INIS; GPO Dep.

The Los Alamos Meson Physics Facility (LAMPF), is a linear particle accelerator a half-mile long. It produces an 800 million electron- volt hydrogen-ion beam at an average current of more than one milliamp. The first RF section of the accelerator consists of four Alvarez drift-tube structures. Each of these structures is excited by an amplifier module at a frequency of 201.25 MHz. These amplifiers operate at a duty of 13 percent or more and at peak pulsed power levels of about 2.5 million watts. The second RF accelerator section consists of forty-four side-coupled-cavity structures. Each of these is excited by an amplifier module at a frequency of 805 MHz. These amplifiers operate at a duty of up to 12 percent and at peak pulsed power levels of about 1.2 million watts. The relatively high average beam current in the accelerator places a heavy demand upon components in the RF systems. The 201-MHz modules have always required a large share of maintenance efforts. In recent years, the four 201.25 MHz modules have been responsible for more than twice as much accelerator down-time as have the forty-four 805 MHz modules. This paper reviews recent, ongoing, and planned improvements in the 201-MHz systems. The Burle Industries 7835 super power triode is used in the final power amplifiers of each of the 201-MHz modules. This tube has been modified for operation at LAMPF by the addition of Penning ion vacuum"pumps." This has enabled more effective tube conditioning and restarting. A calorimetry system of high accuracy is in development to monitor tube plate-power dissipation.

**34899** (LA-UR–91-3112) **Progress with the slotted-tube pulsed microwiggler.** Warren, R.W. Los Alamos National Lab., NM (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36.

(CONF-9108118–6: 13. international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000173. Source: OSTI; NTIS; INIS; GPO Dep.

A pulsed microwiggler can produce a wiggler field of unusually short period and high strength. A period of a few millimeters and a field of 5 appear possible. A satisfactory design is hard to realize, however, for many reasons: the high current, the current nonuniformities caused by the skin effect, thermal stresses in the parts, the high precision, etc. In addition, measuring the field with adequate resolution in the time domain, as well as in all three spatial coordinates, is challenging, particularly inside the small bore of a microwiggler. This paper presents recent design modifications that illustrate new solutions to these problems, and details of the construction, testing, and performance of wigglers already built. 6 refs., 5 figs.

**34900** (LBL–29943) **Operating experience with the ALS linac.** Selph, F.; Massoletti, D. Lawrence Berkeley Lab., CA (United States). May 1991. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-910505–410: 1991 Institute of Electrical and Electronics Engineers (IEEE) particle accelerator conference (PAC), San Francisco, CA (United States), 6-9 May 1991). Order Number DE92000923. Source: OSTI; NTIS; INIS; GPO Dep.

The linac injector for the Advanced Light Source (ALS) at LBL was recently put into operation. Energy is 50 MeV, frequency 3 GHz. The electron gun delivers up to 6nC in a 3.0-ns bunch at 120 kV. A train of bunches is injected into a 1-Hz booster and accelerated to 1.5 GHz for storage ring injection. A magnetic analysis system is used for optimizing the linac. Measured beam properties from the gun and after acceleration in the linac are described. 9 refs., 3 figs.

**34901** (LBL–29944) **Magnetic data analysis for the ALS lattice magents.** Keller, R. Lawrence Berkeley Lab., CA (United States). May 1991. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-910505–411: 1991 Institute of Electrical and Electronics Engineers (IEEE) particle accelerator conference (PAC), San Francisco, CA (United States), 6-9 May 1991). Order Number DE92000924. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Light Source (ALS), now under construction at Lawrence Berkeley Laboratory, is a third-generation synchrotron radiation source designed to produce extremely bright photon beams in the UV and soft X-ray regions. The lattice magnets to be installed in the two rings, a 1–1.9 GeV storage ring, and a 1.5 GeV booster synchrotron, have been magnetically measured to ascertain their excitation curves and field uniformity. In this paper the analysis of these data is discussed, and results for measured magnets are given. 5 refs., 2 figs., 7 tabs.

**34902** (LBL–29976) **Quantum yield measurements of photocathodes illuminated by pulsed ultraviolet laser radiation.** Young, A.T. (Lawrence Berkeley Lab., CA (United States)); Chen, P.; Kunkel, W.B.; Leung, K.N.; Li, C.Y.; Watson, J.M. Lawrence Berkeley Lab., CA (United States). May 1991. 4p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-910505–407: 1991 Institute of Electrical and Electronics Engineers (IEEE) particle accelerator conference (PAC), San Francisco, CA (United States), 6-9 May 1991). Order Number DE92000859. Source: OSTI; NTIS; INIS; GPO Dep.

The electron quantum yields from polycrystalline lanthanum hexaboride and barium irradiated by near ultraviolet laser excitation have been determined. These measurements show that the quantum yields from these materials are dependent on the processing and previous history of the photocathode material. For lanthanum hexaboride, a yield of $7 \times 10^{-6}$ with 337 nm irradiation has been achieved. For barium, a yield of $1 \times 10^{-6}$ has been measured with excitation at 308 nm. These results are discussed and future plans are outlined. 4 refs., 4 figs.

**34903** (LBL–30459) **The U5.0 Undulator for the ALS.** Hoyer, E.; Chin, J.; Halbach, K.; Hassenzahl, W.V.; Humphries, D.; Kincaid, B.; Lancaster, H.; Plate, D. Lawrence Berkeley Lab., CA (United States). 15 Jul 1991. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-910730–15: 4. international conference on synchrotron radiation instrumentation, Chester (United Kingdom), 15-19 Jul 1991). Order Number DE92000955. Source: OSTI; NTIS; INIS; GPO Dep.

the U5.0 Undulator, and 89 period, 5 cm period length, 4.6 m long insertion device has been designed, is being fabricated and is scheduled for completion in early 1992. This undulator will be the first high brightness source, in the 50 to 1500 eV range, for the Advanced Light Source (ALS) at the Lawrence Berkeley Laboratory. A hybrid magnetic configuration using Nd-Fe-B permanent magnet material and vanadium permendur poles has been selected to achieve the field quality needed to meet performance requirements. The magnetic structure is modular with each half consisting of 5 assembly sections, which provide the periodic structure, and end structures, for entrance and exit correction, mounted on a steel backing beam. Each assembly section consists of 35 half-period pole assemblies bolted to a mount. The required 0.837 Tesla effective peak field at a 1.4 cm gap has been verified with model measurements. Vertical field integral correction is accomplished with the end structures, each having an arrangement of permanent magnet rotors which will be adjusted to minimize electron beam missteering over the undulator operating field range. To reduce the effect of environmental fields, the steel backing beams are connected through parallel, low-reluctance, Ni-Fe hinges. The magnetic structure is connected through four roller-nuts to the drive system that provides gap adjustment with an arrangement of roller screws, chain drives, a gear reduction unit and a stepper motor driven by a closed loop control system. Magnetic structure and drive system support are from a 2.4 m high structure which includes a support base with four vertical supports. The vacuum chamber design is a two-piece machined and welded 5083-H321 aluminum construction of 5.1 m length. Pumping is with a combination of ion, TSP and NEG pumps. Magnetic design, subsystem design and fabrication progress are presented.

**34904** (LBL–30668) **Magnetic field in the SSC arc quad.** Caspi, S.; Helm, M.; Laslett, L.J. Lawrence Berkeley Lab., CA (United States). 29 Apr 1991. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (SC-MAG–336). Order Number DE92000656. Source: OSTI; NTIS; INIS; GPO Dep.

In part one we report on field calculations along the conductor in the end region of the SSC arc-quad. We have determined that the maximum field in the 2D section is 5.04 tesla located at the pole turn of the inner layer somewhere in the middle of the cable (strand 9)(fields are at 6500 A). At the "end" the maximum field is slightly higher 5.09 tesla located at the overpass (strand 11). The iron contribution was included assuming infinite permeability. In part two we include results of a 3D representation of the magnetic field inside the bore. The complete analysis, for which a brief description has been included here, is described elsewhere. This form for presenting the field is suitable for interfacing with other codes that make use of the 3D field components (particle tracking and stability). 69 figs.

**34905** (LBL–30724) **Alternative positron-target design for electron-positron colliders.** Donahue, R.J. (Lawrence Berkeley Lab., CA (United States)); Nelson, W.R. Lawrence Berkeley Lab., CA (United States); Stanford Linear Accelerator Center, Menlo Park, CA (United States). Apr 1991. 53p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;AC03-76SF00515. Order Number DE92000648. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis. Submitted by Richard J. Donahue to University of Lowell.

Current electron-positron linear colliders are limited in luminosity by the number of positrons which can be generated from targets presently used. This paper examines the possibility of using an alternate wire-target geometry for the production of positrons via an electron-induced electromagnetic cascade shower. 39 refs., 38 figs., 5 tabs.

**34906** (LBL–31195) **Photon storage cavities.** Kim, K.J.; Sessler, A.M. Lawrence Berkeley Lab., CA (United States). Aug 1991. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9108118–11: 13.

international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000921. Source: OSTI; NTIS; INIS; GPO Dep.

A general analysis is presented of a photon storage cavity, coupled to free-electron laser (FEL) cavity. It is shown that if the coupling between the FEL cavity and the storage cavity is unidirectional (for example, a ring resonator storage cavity) then storage is possible, but that if the coupling is bi-directional then storage is not possible. Parameters are presented for an infra-red FEL storage cavity giving an order of magnitude increase in the instantaneous photon power within the storage cavity. 4 refs., 3 figs.

**34907** (LBL–31196) **Three-dimensional simulation of a hole-coupled FEL oscillator.** Krishnagopal, S.; Xie, M.; Kim, K.J.; Sessler, A. Lawrence Berkeley Lab., CA (United States). Aug 1991. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (ESG–152;CONF-9108118–9: 13. international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000810. Source: OSTI; NTIS; INIS; GPO Dep.

The performance of a two-mirror resonator with holes for outcoupling has been examined in a previous study in which the FEL gain was neglected, but the geometrical effect of the wiggler aperture was included in the optical calculation. The phenomenon of mode degeneracy was found to occur, that has serious implications for the stability of performance when the FEL gain is included. We have developed a FEL oscillator code based on "TDA", a three-dimensional FEL amplifier code, to study the mode characteristics in the presence of an FEL. We find that the interaction of the radiation and the FEL has an important, and positive, impact on the mode-profile and related cavity performance parameters. In particular, mode degeneracy is not expected to be a serious problem for reasonable FEL oscillator designs. 8 refs., 4 figs., 1 tab.

**34908** (LBL–31197) **Discrete cavity model of a standing-wave free-electron laser.** Rangarajan, G. (Lawrence Berkeley Lab., CA (United States)); Sessler, A.; Sharp, W.M. Lawrence Berkeley Lab., CA (United States). Aug 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098 ;W-7405-ENG-48. (CONF-9108118–10: 13. international free-electron laser (FEL) conference, Santa Fe, NM (United States), 25-30 Aug 1991). Order Number DE92000839. Source: OSTI; NTIS; INIS; GPO Dep.

A standing-wave free-electron laser (SWFEL) has been proposed for use in a two-beam accelerator (TBA). Unlike a conventional microwave free-electron laser, the SWFEL has a wiggler that is divided by irises into a series of standing-wave cavities, and the beam is reaccelerated by induction cells between cavities. We introduce a one-dimensional discrete-cavity model of the SWFEL. In contrast to the continuum model that has been extensively used to study the device, the new model takes into account time-of-flight effects within the cavity and applies the reacceleration field only between cavities, where the pondermotive force is absent. As in previous SWFEL models, only a single frequency is considered. Using this model, effects of finite cavity length are investigated. For moderately long cavities, it is shown that there are no adverse effects on the phase stability of the device. 4 refs., 3 figs., 1 tab.

**34909** (SAND–91-0178C) **Status of the Repetitive High Energy Pulsed Power Project.** Harjes, H.C.; Penn, K.J.; Reed, K.W.; McClenahan, C.R.; Laderach, G.E.; Wavrik, R.W.; Adcock, J.; Butler, M.; Mann, G.A.; Martinez, L.; Morgan, F.A.; Weber, G.J.; Neau, E.L. Sandia National Labs., Albuquerque, NM (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-910640–44: 8. IEEE pulsed power conference, San Diego, CA (United States), 17-19 Jun 1991). Order Number DE91018359. Source: OSTI; NTIS; GPO Dep.

High average power pulse compression systems are being considered for use in several applications. The Repetitive High Energy Pulsed Power (RHEPP) system will consist of a 7 stage magnetic pulse compressor driving a linear induction voltage adder with an e-beam diode load. It is being designed to deliver 350 kW of average power to the diode in 60 ns FWHM, 2.5 MV, 2.9 kJ pulses. Input power for the module is presently supplied by a 600 kW, 120 Hz, alternator (developed by Westinghouse Electric Corporation). Two stages in a bipolar, 2.5 kJ/pulse output mode [1,2]. These stages are now being modified to operate in a unipolar, 5 kJ/pulse output mode. The design of the system is proceeding and several experiments are being conducted to support the design effort. A discussion of these experiments, the system design, and the status of the project is presented. 19 refs., 10 figs., 3 tabs.

**34910** (SLAC-PUB–5587) **Design of a trigger and data acquisition system for the SLAC/LBL/LLNL B Factory.** Briggs, D. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Jul 1991. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9104295–1: KEK workshop on B factory, Tsukuba (Japan), 15-18 Apr 1991). Order Number DE91018879. Source: OSTI; NTIS; INIS; GPO Dep.

This report compares and contrasts the approaches taken at KEK and SLAC in the design of trigger and data acquisition systems for the high-luminosity environment of a B Factory. The description of the SLAC design presented obtains from work in progress by a working group of an ongoing workshop. 3 refs., 10 figs.

**34911** (SLAC-PUB–5631) **Manufacture of fast-pulsed magnets for the SLC damping rings.** Cassel, R.; Gross, G.; Harvey, A.; Mattison, T. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Jun 1991. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-910662–1: 12. international conference on magnet technology, Leningrad (USSR), 23-28 Jun 1991). Order Number DE91018881. Source: OSTI; NTIS; GPO Dep.

A second-generation fast kicker magnet (and its power supply) was designed by Fermilab for the SLC electron damping ring. Many of the early problems with these magnets have been studied intensely during the last two years, and substantial progress has been made. In particular, vacuum potting with room-temperature curing silicone rubber (RTV) has been refined to give reliable high-voltage service up to 18 kV/mm, and life-times of about a year despite stored beam intensities of $3 \times 10^{10}$ electrons/bunch at 120 pps. Further improvements in RTV formulation are suggested, and the direction of future insulation-system development is indicated.

**34912** (SSCL–364) **Status of 4-cm-aperture, 17-m-long SSC dipole magnet R&D program at BNL: Part 1, Magnet assembly.** Devred, A. (Superconducting Super Collider Lab., Dallas, TX (United States)); Bush, T.; Coombes, R.; DiMarco, J.; Goodzeit, C.; Kuzminski, J.; Puglisi, M.; Radusewicz, P.; Sanger, P.; Schermer, R.; Tompkins, J.; Turner, J.; Wolf, Z.; Yu, Y.; Zheng, H.; OgiSuperconducting Super Collider Lab., Dallas, TX (United States). Mar 1991. 25p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-910340–50: 3. annual international industrial symposium on the super collider (IISSC), Atlanta, GA (United States), 13-15 Mar 1991). Order Number DE92000461. Source: OSTI; NTIS; INIS; GPO Dep.

Over the last year, several 4-cm-aperture, 17-m-long dipole magnet prototypes were built by Brookhaven National Laboratory (BNL) under contract with the Superconducting Super Collider (SSC) Laboratory. These prototypes are the last phase of a half-decade-long R&D program, carried out in collaboration with Fermi National Accelerator Laboratory and Lawrence Berkeley Laboratory, and aimed at demonstrating the feasibility of the SSC main ring magnets. They also lay the ground for the 5-cm aperture dipole magnet program to be started soon. After reviewing the design features of the BNL 4-cm-aperture, 17-m-long dipole magnets, we describe in detail the various steps of their fabrication. For each step, we discuss the parameters that need to be mastered, and we compare the values that were achieved for the five most recent prototypes. The data appear coherent and reproducible, demonstrating that the assembly process in under control. 23 refs., 10 figs., 4 tabs.

**34913** (SSCL–391) **The SSC field Bus: A high-performance control system front end concentrator for "slow" accelerator controls.** Haenni, D.R.; Saltmarsh, C.G.; Lue, H.C.; Hunt, S.M. Superconducting Super Collider Lab., Dallas, TX (United States). Mar 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-910340–48: 3. annual international industrial symposium on the super collider

(IISSC), Atlanta, GA (United States), 13-15 Mar 1991). Order Number DE91018734. Source: OSTI; NTIS; INIS; GPO Dep.

The SSC control system must support a large number of "slow" or industrial type control points. A front-end system is described which could serve as both a data concentrator and a distributed process controller for these points. Unlike many distributed control systems, this front end is designed to provide strong support for centralized controls. The live parameter data base in the central system can be updated as a rate which is fast compared to that usually needed for process control loops. Portions of this data base can be optionally replicated in regional computers to provide both local control stations and distributed control loops. In addition to the global and regional levels the system also allows the distribution of loops to the local I/O crate level. A possible implementation of this system is under development which is based on industrial standard STD-Bus for accelerator hardware interfacing, time domain multiplexing (TDM) for communications transport, and a form of reflective memory for the back-end interface to the rest of the control system. 6 figs.

**34914** (SSCL–403) **Resolutions to difficulties experienced in SSC cable fabrication during the initial scale-up period.** Hannaford, R. (Superconducting Super Collider Lab., Dallas, TX (United States)); Christopherson, D.; Remsbottom, B.; Boivin, M. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1990. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-900944–54: 1990 applied superconductivity conference, Snowmass, CO (United States), 24-28 Sep 1990). Order Number DE92001661. Source: OSTI; NTIS; INIS; GPO Dep.

Late in 1988, a prototype high speed cable machine was built by industry and delivered in FY88 for the Superconducting Super Collider (SSC), and delivered to New England Electric Wire Corp. for the fabrication of SSC cable. This cabling machine has produced the majority of the cable needed for the SSC Dipole Program. During the past year and a half we have experienced several cabling difficulties that were not seen previously. These difficulties were due to new techniques and equipment relating to the high speed production of cable meeting SSC specifications. These difficulties included mandrel alignment, Turk's-head roller alignment, and Turk's-head drive equipment. The solution to these problems are discussed with the SSC specification in detail. 2 refs., 6 figs.

**34915** (SSCL–404) **SSC 40 mm cable results and 50 mm design discussions.** Christopherson, D. (Superconducting Super Collider Lab., Dallas, TX (United States)); Capone, D.; Hannaford, R.; Remsbottom, R.; Jayakumar, R.; Snitchler, G.; Scanlan, R.; Royet, J. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1990. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-900944–53: 1990 applied superconductivity conference, Snowmass, CO (United States), 24-28 Sep 1990). Order Number DE92001660. Source: OSTI; NTIS; INIS; GPO Dep.

A summary of the cable produced for the 1990 40 mm Dipole Program is presented. The cable design parameters for the 50 mm Dipole Program are discussed, as well as portions of the SSC specification draft. Considerations leading to the final cable configuration and the results of preliminary trials are included. The first iteration of a strand mapping program to automate cable strand maps is introduced. 7 refs., 2 figs., 1 tab.

**34916** (SSCL–405) **Mechanical and electromagnetic analysis of 50 millimeter designs for the SSC dipole.** Jayakumar, J. (Superconducting Super Collider Lab., Dallas, TX (United States)); Leung, K.; Nobrega, F.; Orrell, D.; Sanger, P.; Snitchler, G.; Spigo, G.; Turner, J.; Goodzeit, C.; Gupta, R.; Kahn, S.; Morgan, G.; Willen, E.; Kerby, J.; Strait, J.; SchermeSuperconducting Super Collider Lab., Dallas, TX (United States). Sep 1990. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-900944–52: 1990 applied superconductivity conference, Snowmass, CO (United States), 24-28 Sep 1990). Order Number DE92001659. Source: OSTI; NTIS; INIS; GPO Dep.

Several designs for the Superconducting Super Collider dipole magnet have been analyzed. This note discusses the mechanical and electromagnetic features of each design. Electromagnetic and Mechanical analyses were performed using hand, computer programs and finite element techniques to evaluate the design. 10 refs., 6 figs., 3 tabs.

**34917** (SSCL–406) **Quench propagation in the SSC dipole magnets.** Lopez, G.; Snitchler, G. Superconducting Super Collider Lab., Dallas, TX (United States). Sep 1990. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. (CONF-900944–51: 1990 applied superconductivity conference, Snowmass, CO (United States), 24-28 Sep 1990). Order Number DE92001658. Source: OSTI; NTIS; INIS; GPO Dep.

The effects of quench propagation are modeled in 40mm and 50mm diameter collider dipole magnet designs. A comparative study of the cold diode (passive) and quench heater (active) protection schemes will be presented. The SSCQ modeling program accurately simulates the axial quench velocity and uses phenomenological time delays for turn-to-turn transverse propagation. The axial quench velocity is field dependent and consequently, each conductor's quench profile is tracked separately. No symmetry constraints are employed and the distribution of the temperatures along the conductor differs from the adiabatic approximation. A single magnet has a wide margin of self protection which suggests that passive protection schemes must be considered. 6 refs., 3 figs., 1 tab.

**34918** (SSCL–484) **The SSC beam scraper system.** Maslov, M.A. (Superconducting Super Collider Lab., Dallas, TX (United States)); Mokhov, N.V.; Yazynin. Superconducting Super Collider Lab., Dallas, TX (United States). Jun 1991. 54p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486. Order Number DE92001606. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we present the results of a full-scale study of a beam scraping system that is designed to guarantee reliable operation of the SSC throughout the whole cycle and for minimum background for experiments at the interaction regions. The machine aperture limits and beam loss formation are analyzed. Simulation programs and a calculational model are described. The physics of beam scraping is explored, and measures to increase significantly the system efficiency are determined. A tolerable scraping rate, taking into account scraper material integrity, quench limits in downstream superconducting magnets, radiation shielding requirements, and minimal beam halo levels at the IPs are also determined. Finally, a complete multi-component scraper system in the SSC East Cluster is proposed. Throughout the paper we define a scraper as a primary absorber consisting of precise movable jaws that have a flat inner edge along the circulation beam and which may be forced to touch the beam halo in horizontal or vertical planes. Secondary absorbers – collimators – are destined to intercept outscattered protons and other particles produced in scraper material. All these are surrounded with a radiation shielding. 15 refs., 50 figs., 13 tabs.

**34919** (SSCL–487) **Status of 4-cm-aperture, 17-m-long SSC dipole magnet R&D program at BNL: Part 2, Mechanical behavior.** Devred, A. (Superconducting Super Collider Lab., Dallas, TX (United States)); Bush, T.; Coombes, R.; DiMarco, J.; Goodzeit, C.; Kuzminski, J.; Puglisi, M.; Radusewicz, P.; Sanger, P.; Schermer, R.; Spigo, G.; Tompkins, J.; Turner, J.; Wolf, Z.; Yu, Y.; ZheSuperconducting Super Collider Lab., Dallas, TX (United States). Jun 1991. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC35-89ER40486 ;AC02-76CH03000 ;AC03-76SF00098. (FNAL/C–91/188;LBL–31038;CONF-910635–15: Cryogenic engineering conference and international cryogenic materials conference, Huntsville, AL (United States), 11-14 Jun 1991). Order Number DE92000460. Source: OSTI; NTIS; INIS; GPO Dep.

Over the last year-and-a-half, several 4-cm-aperture, 17-m-long dipole magnet prototypes were built by Brookhaven National Laboratory (BNL) under contract with the Superconducting Super Collider (SSC) Laboratory. These prototypes are the last phase of a half-decade-long R&D program, carried out in collaboration with Fermi National Accelerator Laboratory and Lawrence Berkeley Laboratory, and aimed at demonstrating the feasibility of the SSC main ring dipole magnets. They also prepare the way of the 5-cm-aperture dipole magnet program to be started soon. In this paper,

we analyze the mechanical behavior of the BNL prototypes during cool-down and excitation, and we attempt to relate this behavior to the magnet features. The data reveal that the mechanical behavior is sensitive to the vertical collar-yoke interference, and that the magnets exhibited somewhat erratic changes in coil end-loading during cool-down. 9 refs., 6 figs.

## 4304 Storage Rings

*Refer also to citation(s) 35348*

**34920** (DESY–91-036) **Transverse and longitudinal multi-bunch feedback systems for PETRA.** Ebert, M.; Heins, D.; Klute, J.; Kohaupt, R.D.; Matthiesen, K.H.; Meinen, J.; Musfeldt, H.; Paetzold, S.; Richter, K.H.; Ruemmler, J.; Scholz, H.P.; Schweiger, M.; Sommerfeld, M.; Theiss, J. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Apr 1991. 34p. Order Number DE92714310. Source: OSTI; NTIS (US Sales Only); INIS.

A severe intensity limitation for the PETRA and HERA $e^-$ rings is connected with the coupled bunch motion. The multi-bunch instabilities are driven by the parasitic modes of the accelerating cavities, thus limiting the total current. The threshold currents depend on the actual configuration of the parasitic modes and the Landau damping. During the last run, the Landau decay time in the transverse direction was measured at around 10 msec, the threshold current was just below 3 mA. In the longitudinal direction the decay time was 15 msec and the threshold current around 10 mA. In order to get rid of the brutal current limitations, a wide-band multi-bunch system was built and installed in PETRA for all three directions. The transverse system had been tested earlier. After the longitudinal system had been completed and after an essential improvement of the signal quality in the transverse direction, the damping time achieved was around 200 $\mu$sec in all three directions for all transverse and longitudinal modes for 70 bunches with a spacing of 96 nsec. The total current reached was 56 mA which is the current needed to fill HERA. The beam was completely stable at those currents and the intensity of the bunches distributed around the ring was constant within less than 5%. (orig.).

**34921** (DESY–91-047) **A canonical eight-dimensional formalism for linear and non-linear classical spin-orbit motion in storage rings.** Barber, D.P.; Heinemann, K.; Ripken, G. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 58p. Order Number DE92714440. Source: OSTI; NTIS (US Sales Only); INIS.

In the following report we begin to reformulate work by Derbenev on the behaviour of coupled quantized spin-orbit motion. To this end we present a classical symplectic treatment of linear and non-linear spin-orbit motion for storage rings using a fully coupled eight-dimensional formalism which generalizes earlier investigations of coupled synchro-betatron oscillations by introducing two additional canonical spin variables which behave, in a small-angle limit, like those already used in linearised spin theory. Thus in addition to the usual x-z-s couplings, both the spin to orbit and orbit to spin coupling are described canonically. Since the spin Hamiltonian can be expanded in a Taylor series in canonical variables, the formalism is convenient for use in 8-dimensional symplectic tracking calculations with the help, for example, of Lie algebra or differential algebra for the study of chaotic spin motion, for construction of spin normal forms and for the study of the effect of Stern-Gerlach forces. (orig.).

**34922** (JAERI-M–91-068) **Study on beam lifetime of JSR.** Yokoyama, Minoru (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Yanagida, Kenichi; Nagai, Takahisa; Harada, Shunji; Yokomizo, Hideaki; Mashiko, Katuo; Ishizaki, Nobuhiro; Tayama, Hidekazu; Yamada, Koji. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1991. 36p. (In Japanese). Order Number DE92704086. Source: OSTI; NTIS (US Sales Only); INIS.

JSR is a compact electron storage ring constructed in Tokai Research Establishment. Operation of JSR has been started in April 1989. The stored beam current record till July 1990 was about 160mA. In this report, we have discussed mainly the beam lifetime by measuring the decay of stored beam current. (author).

# 44 INSTRUMENTATION

## 4401 Radiation Instrumentation

*Refer also to citation(s) 33724, 33768, 33811, 33815, 33816, 34046, 34047, 34112, 34448, 34702, 34797, 34887, 34910, 35033, 35034, 35035, 35036, 35037, 35038, 35039, 35040, 35041, 35042, 35043, 35044, 35045, 35046, 35047, 35048, 35049, 35050, 35051, 35099, 35154, 35156, 35158, 35159, 35160, 35161, 35163, 35186, 35188, 35190, 35191, 35199, 35207, 35212, 35214, 35261, 35312, 35444, 35513*

**34923** (ANL/CP–74097) **Startup of the Fragment Mass Analyzer at ATLAS.** Davids, C.N. (Argonne National Lab., IL (United States)); Back, B.B.; Bindra, K.; Henderson, D.J.; Kutschera, W.; Lauritsen, T.; Nagame, Y.; Sugathan, P.; Ramayya, A.V.; Walters, W.B. Argonne National Lab., IL (United States). [1991]. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9106151–1: 12. electromagnetic isotope separators and technique related to their applications, Sendai (Japan), 2-6 Jun 1991). Order Number DE91018594. Source: OSTI; NTIS; INIS; GPO Dep.

The Fragment Mass Analyzer (FMA) is currently being brought into operation at the Argonne Tandem Linear Accelerator System (ATLAS). The FMA is a recoil mass spectrometer, 8 m in length, which will be used to separate nuclear reaction products from the primary beam ad disperse them by mass/charge (m/q) at the focal plane. It has a solid angle of 8 msr, an energy acceptance of $\pm$20% around the central energy, and an m/q acceptance of $\pm$7% around the central mass. The FMA will allow the study of gamma rays originating from weak fusion-reaction channels by gating the gamma spectra by the desired ion identified at the FMA focal plane. Production and decay of nuclei far from stability will be studied at the FMA focal plane by implanting exotic recoils directly into detectors or by using a fast tape system to transport the recoils to shielded detector systems. With its capability of rotating from –5 to +45 degrees around the target, the FMA will also be used for reaction mechanism studies. Beta-NMR and nuclear moment measurements will be made behind the focal plane. A facility description and a progress report on the commissioning of the FMA are presented. 13 refs., 9 figs., 1 tab.

**34924** (CIEMAT–628) **Gamma-Ray interaction probabilities for some liquid scintillators.** Garcia-Torano, E.; Grau Malonda, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1989. 29p. (In Spanish). Order Number DE92700001. Source: OSTI; NTIS (US Sales Only).

Interaction probabilities for 17 gamma-Ray energies between 1 and 1.000 KeV have been computed and tabulated. The tables may be applied to the case of cylindrical vials with radius 1,25 cm and volumes 5, 10 and 15 ml. Toluene, Toluene/Alcohol, Dioxane-Naftalene, PCS, INSTAGEL and HISAFE II scintillators are considered. Graphical results for 10 ml are also given. (Author)

**34925** (CIEMAT–675) **Spectral interpolation and unfolding to measure multi-labelled samples by liquid scintillation.** Grau Cortes, A.; Grau Malonda, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1990. 18p. Order Number DE92700013. Source: OSTI; NTIS (US Sales Only).

A new procedure to determine the activity of each radionuclide in a mixture is described. The information contained in the liquid scintillation pulse height spectra is used. The dilatation, interpolation and contraction steps are essential to obtain a good experimental and computed spectra fitting. The procedure can be applied to mixtures of radionuclides decayin by $\beta^-$, $\beta^-$ - $\gamma$, $\beta^+$,$\beta^+$ - $\gamma$, EC, EC - $\gamma$ and isomeric transitions. (Author)

**34926** (CIEMAT–677) **Poissonian and binomial models in radionuclide metrology by liquid scintillation counting.** Grau Malonda, A. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1990. 28p. Order Number DE92700014. Source: OSTI; NTIS (US Sales Only).

Binomial and Poissonian models developed for calculating the counting efficiency from a free parameter is analysed in this paper. This model have been applied to liquid scintillator counting systems

with two or three photomultipliers. It is mathematically demostrated that both models are equivalent and that the counting efficiencies calculated either from one or the other model are identical. (Author)

**34927** (CONF-910137–, pp. 114-117) **Predicted summary of panel discussion on smart instruments.** Sorber, R.E. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The following is a hypothetical account of a panel discussion on Smart Instruments. It enumerates topics that are likely to covered in the actual discussion. A smart instrument may be defined as one that performs smart functions or as one that contains a computer of some sort. Neither definition is perfect. Smart functions might include, but are not limited to: automated data logging (reading, location, time); transfer (downloading) logged data to outside computer; computer assisted, remote calibration; linearity and dead time correction; performance trending; self diagnosis of faults; detector probe recognition; automated beta factor application; and automatic range selection. These smart functions are discussed.

**34928** (CONF-910137–, pp. 127-138) **Development of a low-cost whole body counter.** Smith, M.H. (Texas A and M Univ., College Station (USA)); Gross, G.P. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

This paper documents the construction and calibration of a whole-body counter for the Radiation Safety Office of the Mayo Clinic in Rochester, MN. Changes in the federal regulations may require improved documentation of internal dose for radiation workers. A relatively inexpensive and simple chair-type whole-body counter may suit the needs of many organizations for in vivo assessment of gamma emitting radionuclides. A simple calibration phantom and a spreadsheet computer program were developed in conjunction with the counter. The spreadsheet can be used to calculate an estimate of committed effective dose equivalent based on activity in a subject and data from ICRP Publication 30. Using a count time of 10 minutes, the counter's minimum detectable activity ranged from 370 Bq to 1,110 Bq for $^{60}Co$ and $^{57}Co$ respectively. Other institutions will be able to assemble whole-body counters at low cost, often from surplus components. The spreadsheet is easily adapted to the needs of any institution and uses current methodology to estimate internal dose.

**34929** (CONF-9106107–2) **The GAMMASPHERE.** Lee, I-Yang. Oak Ridge National Lab., TN (United States). [1991]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International conference on new nuclear physics with advanced techniques; Ierapetra (Greece); 23-29 Jun 1991. Order Number DE92000448. Source: OSTI; NTIS; INIS; GPO Dep.

GAMMASPHERE is one of a new generation of gamma ray detector arrays. It consists of 100 Compton-suppressed large volume Ge detectors. The design goal is to achieve high efficiency and peak-to-total value for four to five fold coincidence experiments. Such high-fold coincidence capability will provide new physics opportunities in areas such as high spins, transfer reactions, giant resonances, and astrophysics. The design of the detector and shield has been developed through extensive simulation calculations and an "electronic honeycomb" design was chosen. The electronics and computer systems are capable of operating at 50,000 event/sec. The design and development tasks are being carried out at several laboratories in the US GAMMASPHERE will sited initially at the 88-Inch Cyclotron at LBL as a national facility. The first experiment is planned in early 1993. 7 refs., 7 figs., 2 tabs.

**34930** (CONF-9106235–5) **Nevada Test Site neutron dosimetry-problems/solutions.** Sygitowicz, L.S.; Bastian, C.T.; Wells, I.J.; Koch, P.N. Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States). [1991]. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-89NV10630. From 11. Department of Energy workshop on personnel neutron dosimetry; Las Vegas, NV (United States); 4-7 Jun 1991. Order Number DE91018581. Source: OSTI; NTIS; INIS; GPO Dep.

Neutron dosimetry had been performed at the Nevada Test Site using NTA film or albedo LiF TLDs. In 1987 the dosimeter type was changed from albedo TLDs to the CR-39 track-etch system. This paper reports on the use of track-etch dosimeters at the NTS, including some of the problems encountered in the original processing system, calibration and quality control issues, and changes made to optimize and partially automate the system. While the CR-39 track-etch system is very labor intensive, with expensive quality control requirements, it is attractive for situations where exposures of small magnitude, affecting a few people, come from high-energy neutrons. 1 ref. (MHB)

**34931** (CONF-911004–2) **Advancement and application of bubble detector technology.** Buckner, M.A.; Casson, W.H.; Sims, C.S. Oak Ridge National Lab., TN (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 3. conference on radiation protection and dosimetry; Orlando, FL (United States); 21-24 Oct 1991. Order Number DE91018842. Source: OSTI; NTIS; GPO Dep.

Every field is searching for it's better mouse trap, and the field of dosimetry is no different. Until recently, a dosimetrist would have been hard-pressed to identify an affordable and yet reliably accurate dosimeter for mixed neutron and gamma fields. A new technology has reared it head and is vying for position in the dosimetry community. This relatively young technology is building upon the foundation of the bubble chamber, conceptualized by Glaser in 1952 (Glaser 1952). Although the attitudes surrounding this technology, as with any new development, are somewhat mixed, with the proper combination of tweaking and innovative thought, applications of this technology hold great promise for the future of neutron dosimetry. The Dosimetry Applications Research (DOSAR) facility of Oak Ridge National Laboratory (ORNL) is looking into some innovative applications of this technology. We are investigating options for overcoming its limiting features in hopes of achieving an unprecedented level of proficiency in neutron detection. Among these are the developing and testing of a Combination Area Neutron Spectrometer, CANS, assessing the plausibility of extremity applications, the assembly of an alternative reader for research, investigation of temperature-related effects and how to correct them and considerations on the coming of age of neutron dosimetry via real time detection of bubble formation in Bubble Technology Industries Inc. (BTI) detectors. In the space allowed, we will attempt to answer the questions: (1) What areas hold the greatest promise for application of this emerging technology? (2) What obstacles must be overcome before full-blown application becomes a reality?; and (3) What might the future hold? 11 refs., 6 figs., 3 tabs.

**34932** (DESY–91-026) **Construction and beam test of the ZEUS forward and rear calorimeter.** Andresen, A. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik); Kroeger, W.; Krueger, J.; Ros, E.; Tsurugai, T.; Woeniger, T.; Bamberger, A.; Lindenberg, T.; Poser, T.; Schaecke, D.; Theisen, G.; Troendle, B.; Ullmann, R.; Bargende, A.; CriZEUS Calorimeter Group. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Apr 1991. 85p. (PRC–91-02). Order Number DE92704838. Source: OSTI; NTIS (US Sales Only); INIS.

The forward and rear calorimeters of the ZEUS experiment are made of 48 modules with maximum active dimensions of 4.6 m height, 0.2 m width, 7 $\lambda$ depth and maximum weigth of 12 t. It consists of 1 $X_0$ uranium plates interleaved with plastic scintillator tiles read out via wavelength shifters and photomultipliers. The mechanical construction, the achieved tolerances as well as the optical and electronics readout are described. Ten of these modules have been tested with electrons, hadrons and muons in the momentum range 15-100 GeV/c. Results von resolution, uniformity and calibration are presented. Our main result is the achieved calibration accuracy of about 1% obtained by using the signal from the uranium radioactivity. (orig.).

**34933** (DESY-FH1T–91-01) **Xenon-ethane gases in drift chambers. Studies on the construction of a high-resolution jet chamber.** Schenuit, E. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany); Hamburg Univ. (Germany). Fachbereich 12 - Physik. Mar 1991. 119p. (In German). Order Number DE92714333. Source: OSTI; NTIS (US Sales Only); INIS.

The improvement of position measurement with drift chambers under NPT-conditions using Xenon as gasfilling was investigated and compared to an Argon-Ethane (50/50) filling. It turned out that the space resolution gained with Xenon gas mixtures is highly depending on cell geometry, gas gain and drift field. For a prototype of the central drift chambers of the H1 experiment at HERA filled with Xenon a space resolution of $\sigma_x \simeq 110$ $\mu$m was reached. This is an improvement of roughly 25% compared to the equivalent Argon mixture (Argon-Ethan (50/50)). The energy loss of 5 GeV/c electrons was measured and a resolution $\sigma_{dE/dx} \simeq 6\%$ was found for both gases using the truncated mean method (70% of lowest integrals of 56 cells). It could be shown that the complex end wall structure of the central drift chamber allows a proper operation of the chamber. (orig.).

**34934** (DOE/ER/40310–5) **Photon detector for MEGA: Progress report, July 16, 1990–July 15, 1991.** Gagliardi, C.A.; Tribble, R.E. Texas A and M Univ., College Station, TX (United States). [1991]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-87ER40310. Order Number DE91018529. Source: OSTI; NTIS; INIS; GPO Dep.

During the past year, we have continued work on the photon detector for the MEGA experiment at Los Alamos, a search for the rare decay $\mu \rightarrow e\gamma$ to a sensitivity of a few parts in $10^{13}$. The MEGA photon detector is designed to observe the 52.38 MeV photon produced in a $\mu \rightarrow e\gamma$ decay with an energy resolution of 1.25 MeV, a position resolution of 2 x 5 mm$^2$, a directional resolution of 10°, a time resolution of 500 ps, and an efficiency of 7%. It will consists of four independent concentric cylindrical pair spectrometers mounted within a 1.5 T magnetic field produced by a superconducting solenoid magnet. Each pair spectrometer includes two thin Pb foils to convert photons into $e^+e^-$ pairs, and thereby, determine both their locations and their vector momenta. The inner drift chamber layer includes a delay line cathode to determine the z coordinates needed for track reconstruction. An MWPC located between two Pb layers identifies the conversion layer so that energy loss corrections may be applied, while plastic scintillators provide timing information. Our, group together with a group from the University of Houston, is responsible for the design and construction of the photon detector, as well as developing the computer codes necessary for Monte Carlo simulations and data analysis. During the past year, our efforts have focused primarily on two tasks, delay line cathode read-out and software development. This report describes our recent work on delay lines and data analysis along with a discussion of the new plans for multiplexing in the photon arm.

**34935** (ETDE/ES-mf–2700015) **Precise measurement of muon momenta at LEP using the L3 detector.** Gonzalez, E. Universidad Complutense de Madrid (Spain). Facultad de Ciencias Fisicas. 1990. 157p. (In Spanish). Order Number DE92700015. Source: OSTI; NTIS (US Sales Only).

In this PhD report the author presents the studies and methods developed to achieve the optimization of the resolution in the momentum measurement of the L3 moun detector. Chapters 1 and 2 show the motivations to build a precision muon detector for the LEP $e^+$ $e^-$ collider. Special emphasis is applied to the study of the Higgs scalar boson search and identification and the guiding principles used to design the L3 muon detector are outlined. Chapter 3 is devoted to the description of the drift chambers. They are located in three concentric octagonal cylinders inside one solenoidal magnet, around the interaction point and coaxial with the beams. These chambers are the measuring elements of the detector. The chapter includes the description or the different tests applied to the chambers to obtain their resolution and calibration. In chapter 4 the alignment system of this chambers is described. This system is a key element to the precision of the detector, that being 12 meters long and of 12 meters of diameter has to measure the particles trajectories with precisions of just a few micrometers. Chapter 5 describes the third key piece for the detector precision, the monitoring and control system. It allows to know continually the precise values of the critical parameters of the detector. Finally in chapter 6 the author presents the results of the many test applied to the detector using cosmic rays, UV lasers and even the actual muons produced in the $e^+$ $e^-$ interactions. These tests prove that the L3 muon detector is the most precise measuring system for muon momenta installed at present in one $e^+$ $e^-$ collider ring. (Author)

**34936** (EUR–13307) **Optimization of measurement techniques for very low-level radioactive waste material.** Hoffmann, R. (Siemens AG Unternehmensbereich KWU, Erlangen (DE)); Leidenberger, B. Commission of the European Communities, Luxembourg (Luxembourg). 1991. 88p. Contract FI1D-0048. Source: OSTI; NTIS (US Sales Only).

Relative radiotoxicities of all relevant waste nuclides are defined and calculated according to the limits set by the German Radiation Protection Ordinance. The hard-to-detect nuclides (e.g. Fe-55, Ni-59, Ni-63) are found to be of minor radiological relevance, even if their abundance in certain waste categories is predominant. Standard beta or gamma measurements are highly sufficient if alpha contamination can be excluded. Twenty different detectors were tested and their suitability for release measurements, i.e. detection efficiencies, limits of detection and minimum measuring times, were determined using standards of C-14, Pm-147, Co-60, Cs-137, Sr-90/Y-90, Cr-51 and Am-241 in 5 geometries representative of contaminated waste material. In most geometries, proportional counters were found adequate for release measurements while for detection of alpha radiation in difficult geometries, small detectors (i.e. surface barrier detectors, photodiodes or Geiger-Muller counters) are needed.

**34937** (FNAL/C–91/241) **Tracking and vertex finding with drift chambers and neural networks.** Lindsey, C. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1991. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9106281–1: Workshop on neural networks: from biology to high energy physics, Isola d'Elba (Italy), 5-14 Jun 1991). Order Number DE92000472. Source: OSTI; NTIS; INIS; GPO Dep.

Finding tracks, track vertices and event vertices with neural networks from drift chamber signals is discussed. Simulated feedforward neural networks have been trained with back-propagation to give track parameters using Monte Carlo simulated tracks in one case and actual experimental data in another. Effects on network performance of limited weight resolution, noise and drift chamber resolution are given. Possible implementations in hardware are discussed. 7 refs., 10 figs.

**34938** (FNAL-TM–1753) **Technical memo on new results on CsI photocathodes: Enhancement and aging.** Anderson, D.F. (Fermi National Accelerator Lab., Batavia, IL (United States)); Kwan, S.; Hoeneisen, B.; Peskov, V. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. Order Number DE92000598. Source: OSTI; NTIS; INIS; GPO Dep.

It appears that there are 4 processes involved in the enhancement and aging of a CsI or CsI-TMAE photocathode: water absorption, charging up of the photocathode, a self annealing aging, and a permanent aging. The evidence for these processes are presented. 9 refs., 6 figs.

**34939** (GANIL-T–91-01) **Putting in action the 4$\pi$ $\gamma$ multidetector TAPS at Ganil.** Merrouch, R. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France); Caen Univ., 14 (France). Apr 1991. 94p. (In French). Order Number DE92703740. Source: OSTI; NTIS (US Sales Only).

The study of the hard photons production originating in heavy ion collisions from bremstrahlung radiation or from the decay of neutral mesons like $\pi^0$ and eta, is an original approach towards the understanding of the dynamics of nuclear reactions and of the behaviour of nuclear matter. The 4 $\pi$ multidetector TAPS has been constructed for that purpose. Many european laboratories joined their efforts to achieve the equipment. It is therefore also foreseen to use it at various accelerators delivering heavy ions between 10

and 2000 MeV/u and electrons of up to 800 MeV. In the first part of this work, the reasons for the choice of TAPS are described. The second part describes the particular mechanical set up used at GANIL together with its electronics and data acquisition system. In the third part the methods for simulating the response of the detectors are explained. The fourth and last part contains the data analysis of an experiment using the reaction $^{129}Xe + ^{197}Au$ at 44 MeV/u. The first results are very stimulating and demonstrate that TAPS is well suited to the detection of photons in an important hadronic noise. It has also been demonstrated that the detection of very rare events like subthreshold pions, is possible thanks to the excellent performances of TAPS.

**34940** (IAEA-TECDOC–572, pp. 67-74) **Neutron activation dosimetry in experiments with massive targets irradiated with 1 GeV protons.** Bakhmutkin, S.V. (Radievyj Inst., Leningrad (USSR)); Bogdanov, A.I.; Bogdanov, V.G.; Kucheryuk, V.I.; Nossov, A.A.; Rimski-Korsakov, A.A.; Kocherov, N.P. International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

Foil activation measurements on the surface of massive cylindrical metal targets irradiated with 1Gev protons along the cylinder axis are reported. The reaction rates for 13 dosimetry reactions are reported for aluminium, iron and composite aluminium-uranium targets. The activation on the surface is mainly produced by secondary neutrons generated in multiplication processes inside the massive targets, but effects of possible interference from secondary protons are also discussed. (author). 3 refs, 3 figs, 3 tabs.

**34941** (IAEA-TECDOC–572, pp. 91-92) **Dosimetry of medium energy protons and neutrons in radiation damage simulation experiments: Summary.** Hegedues, F. (Paul Scherrer Inst. (PSI), Villigen (Switzerland)); Green, S.; Green, W.V.; Victoria, M. International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

In 1978 a program was started at the former Swiss Federal Institute for Reactor Research to study first wall material damage of fusion reactors. The program is focused on the "Proton Irradiation Experiment" (PIREX), however other studies, e.g. the usefulness of spallation sources for material damage simulation have also been performed. The dosimetry associated to this program will be shortly described. 3 refs.

**34942** (LBL–30223) **Front-end electronics development for the SSC.** Levi, M. Lawrence Berkeley Lab., CA (United States). Dec 1990. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000652. Source: OSTI; NTIS; INIS; GPO Dep.

This is a status report on electronics development undertaken by the Front-End Electronics Collaboration. The overall goal of the collaboration remains the development by 1992 of complete, architecturally compatible, front end electronic systems for calorimeter, wire drift chamber, and silicon strip readout. We report here a few highlights to give a brief overview of the work underway. Performance requirements and capabilities, selected architectures, circuit designs and test results are presented. 13 refs., 21 figs., 1 tab.

**34943** (LBL–31070) **D$\phi$ vertex drift chamber construction and test results.** Clark, A.R.; Goozen, F.; Grudberg, P.; Klopfenstein, C.; Kerth, L.T.; Loken, S.C.; Oltman, E.; Strovink, M.; Trippe, T.G. Lawrence Berkeley Lab., CA (United States). May 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9105263–: 5. Pisa meeting on advanced detectors, Isola d'Elba (Italy), 26-31 May 1991). Order Number DE92000848. Source: OSTI; NTIS; INIS; GPO Dep.

A jet-cell based vertex chamber has been built for the Dv experiment at Fermilab and operated in a test beam there. Low drift velocity and diffusion properties were achieved using $CO_2$(95%)-ethane(5%) at atmospheric pressure. The drift velocity is found to be consistent with [9.74+8.68(—E—1.25)] $\mu$m/nsec where E is the electric field strength in (kV/cm < —E— z 1.6 kV/cm.) An intrinsic spatial resolution of 60 $\mu$m or better for drift distances greater than 2 mm is measured. The track pair efficiency is estimated to be better than 90% for separations greater than 630 $\mu$m. 8 refs., 6 figs., 1 tab.

**34944** (LBL–31168) **Test beam results from the D0 liquid argon end calorimeter electromagnetic module.** Spadafora, A.L. The D0 collaboration. Lawrence Berkeley Lab., CA (United States). Aug 1991. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9105263–2: 5. Pisa meeting on advanced detectors, Isola d'Elba (Italy), 26-31 May 1991). Order Number DE92000809. Source: OSTI; NTIS; INIS; GPO Dep.

Results are presented from a test beam study of the D0 liquid argon end calorimeter electromagnetic module prior to its installation at the Fermilab Tevatron Collider. Using electron beams with energies ranging from 10–150 GeV we have obtained an energy resolution of 15.7%/$\sqrt{E(GeV)}$ with a small constant term of 0.3% and a linearity of better than $\pm$0.5%. The position resolution of the calorimeter is found to approximately 1 mm for 100 GeV electrons. 7 refs., 8 figs., 3 tabs.

**34945** (MPE–224) **Energy resolution limits of X-ray sensitive pn CCDs.** Schreiber, W. Max-Planck-Institut fuer Physik und Astrophysik, Garching (Germany). Inst. fuer Extraterrestrische Physik; Muenchen Univ. (Germany). Sektion Physik. Jan 1991. 60p. (In German). Order Number DE92711164. Source: OSTI; NTIS (US Sales Only); INIS.

One of three X-ray telescopes onboard the XMM mission will be equipped with a pn CCD camera, which is currently being developped at the Max Planck-Institut fuer Extraterrestrische Physik. The use of silicon pn CCDs, basing on a novel concept, is described. (UPO).

**34946** (PNL-SA–19841) **Minimum detectable activities of contamination control survey equipment.** Goles, R.W.; Baumann, B.L.; Johnson, M.L. Pacific Northwest Lab., Richland, WA (United States). Aug 1991. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9108162–3: Department of Energy (DOE) radiation protection conference, Knoxville, TN (United States), 27-29 Aug 1991). Order Number DE92000393. Source: OSTI; NTIS; INIS; GPO Dep.

The Instrumentation & External Dosimetry (I&ED) Section of the Health Physics Department at the Pacific Northwest Laboratory (PNL) has performed a series of tests to determine the ability of portable survey instruments used at Hanford to detect radioactive contamination at levels required by DOE 5480.11. This semi-empirical study combines instrumental, statistical, and human factors as necessary to derive operational detection limits. These threshold detection values have been compared to existing contamination control requirements, and detection deficiencies have been identified when present. Portable survey instruments used on the Hanford Site identify the presence of radioactive surface contamination based on the detection of $\alpha$-, $\beta$-, $\gamma$-, and/or x-radiation. However, except in some unique circumstances, most contamination monitors in use at Hanford are configured to detect either $\alpha$-radiation alone or $\beta$- and $\gamma$-radiation together. Testing was therefore conducted on only these two categories of radiation detection devices. Nevertheless, many of the results obtained are generally applicable to all survey instruments, allowing performance evaluations to be extended to monitoring devices which are exclusively $\gamma$- and/or x-ray- sensitive. 6 figs., 2 tabs.

**34947** (SLAC-PUB–5655) **A comparison of the neutron response of CR-39 made by different manufacturers.** Ipe, N.E. (Stanford Linear Accelerator Center, Menlo Park, CA (United States)); Liu, J.C.; Buddemeier, B.R.; Miles, C.J.; Yoder, R.C. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1991. 9p. Sponsored by USDOE, Washington, DC

(United States). DOE Contract AC03-76SF00515. (CONF-911029–1: 7. symposium on neutron dosimetry, Berlin (Germany), 14-18 Oct 1991). Order Number DE92000938. Source: OSTI; NTIS; INIS; GPO Dep.

CR-39 was obtained from American Acrylics and Plastics, Inc. (A.A), N. E. Technology, Ltd. (N.E), and Tech/Ops Landauer, Inc. (LT). The dosemeters were exposed to radioisotopic neutron sources at SLAC, and moderated $^{252}Cf$ at ORNL. The A.A. and N.E. dosemeters were electrochemically etched (pre-etch in 6.5 N KOH at 60°C for 1 hour and 45 minutes, a 5 hour etch at 3000 V and 60 Hz, a 23 minute blow-up step at 2 kHz and a post-etch for 15 minutes). Track densities were determined with the Homann Track Size Image Analyzer. The LT dosemeters were chemically etched in 5.5 N NaOH at 70°C for 15.5 hours. Some A.A., N.E., and LT dosemeters were etched in 6.25 N NaOH at 70°C for 6 hours. A pre-etch step in 60% methanol and 40% NaOH at 70°C for 1 hour was added for some N.E. dosemeters. The results of these studies are reported in this paper. 3 refs., 2 figs., 2 tabs.

**34948** (UCRL-JC–107669) **A portable 0.5- to 16-MeV neutron spectrometer using a liquid scintillator.** Clark, J.C.; Thorngate, J.H. Lawrence Livermore National Lab., CA (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9106235–4: 11. Department of Energy workshop on personnel neutron dosimetry, Las Vegas, NV (United States), 4-7 Jun 1991). Order Number DE91018465. Source: OSTI; NTIS; GPO Dep.

We have been developing a portable neutron spectrometer based on liquid scintillator detector that is capable of measuring fast neutron spectra in the range of 0.5 to 16 MeV. These spectral data are needed for the calibration of neutron dosimeters and calculation of fluence-to-dose conversion factors. Recent development of low-power integrated circuits and the availability of powerful low-cost computers combine to make possible the development of a truly portable instrument. The complete spectrometer will consist of the spectrometer head, which is described in this report, a separate battery pack, and a laptop computer with the appropriate interface to the spectrometer head. 3 figs.

**34949** (Y/TR–90/14) **Radiation detector.** Ashibe, Kusuo (Tokyo Shibaura Electrical Co., Ltd., Tokyo (Japan)). Oak Ridge Y-12 Plant, TN (United States). [1990]. 12p. Translation of Japanese Patent Application Sho 53[1978]-31031, March 20, 1978, application date September 26, 1979. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91018436. Source: OSTI; NTIS; GPO Dep.

This invention concerns a type of radiation detector for detecting radioactive substances contained in gaseous or liquid samples. More specifically, this invention concerns a type of radiation detector which can detect the radiation of the $\beta$-ray radiating nuclear species at a high sensitivity. It is well known that in a nuclear power facility or other facility for handling radioactive substances, it is usually necessary to monitor the radioactive substances in the tail gas or exhausted water and to measure the radiation level of the radioactive substances in the gaseous or liquid samples. In many cases, however, the radiation level by the sample is very low. Hence, the radiation detector used for this purpose must have a high sensitivity, a low price, and should be easy to handle. A radiation detector characterized by the following features: it has a stagnation vessel with a suction port and a discharge port for the fluid being measured, phosphor pieces which contained in the vessel and emit fluorescence when irradiated by radiation, a pair of photomultipliers which detect the fluorescence from the phosphor pieces and convert it to electrical pulses, and breeder circuits; said phosphor pieces are made of two or more transparent fluorescent material flat plates laminated at a specified spacing in slit form, and the photomultipliers are located on the two sides with their photodetecting faces parallel to said flat faces of said phosphor pieces and with said phosphor pieces sandwiched between them. 5 figs.

**34950** (Y/TR–90/15) **Process and device for the measurement of low levels of radioactivity in liquids.** Ralkova, J. (Ceskoslovenska Akademie Ved (CS)). Oak Ridge Y-12 Plant, TN (United States). [1990]. 10p. Translation of French Patent 1,287,232, January 29, 1962. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91018486. Source: OSTI; NTIS; INIS; GPO Dep.

The invention is extended particularly to the characteristics below and to their possible combinations. A process for the measurement of low levels of radioactivity in liquids, a process characterized by the fact that one introduces the test sample of the liquid to be measured into a cuvette made of plastic scintillator material, and one places the cuvette with the test sample between photoelectric multipliers, with the sparks produced in the walls of the cuvette or in the scintillator material being recorded by the photoelectric multipliers, a process which is fast, sensitive, and precise. A device for application of the preceding process or similar process with photoelectric multipliers connected in a coincidence circuit, the scintillation core being surrounded by a counter forming an anticoincidence envelope, device which is characterized by a cuvette containing the test sample to be measured and consisting of a scintillator material or containing this material; said cuvette can be placed in an interchangeable manner between photoelectric multipliers. 2 figs.

## 4402 Radiation Effects on Instrument Components, Instruments, or Electronic Systems

**34951** (SAND–89-0167C) **An assessment of the radiation tolerance of large satellite memories in low earth orbits.** Browning, J.S. (Sandia National Labs., Albuquerque, NM (United States)); Griffee, J.W.; Holtkamp, D.B.; Priedhorsky, W.C. Sandia National Labs., Albuquerque, NM (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109232–2: RADECS 91: radiation effects on components and systems, Montpellier (France), 9-12 Sep 1991). Order Number DE91018353. Source: OSTI; NTIS; INIS; GPO Dep.

A procedure is described that assures the reliable operation in space radiation environments of memory systems that are approximately ten times larger and can be built at about one tenth of the cost of recent, comparable satellite projects. The procedure accounts for combined radiation effects, permitting the radiation tolerance of the memory system to be accurately estimated. Using the procedure a 1-gigabit memory with error detection and correction capability has been designed for miniature satellite applications. The memory system is constructed entirely out of commercial grade microelectronics. 8 refs., 5 figs.

**34952** (UCRL-ID–107566) **High energy SEU test results for the commercially available MIPS R3000 microprocessor and R3010 floating point unit.** Shaeffer, D.L. (Lawrence Livermore National Lab., CA (United States)); Kimbrough, J.R.; Denton, S.M.; Kaschimitter, J.L.; Wilburn, J.W.; Davis, R.W.; Colella, N.J.; Holtkamp, D.B. Lawrence Livermore National Lab., CA (United States). 15 Aug 1991. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91019019. Source: OSTI; NTIS; GPO Dep.

Single event upset (SEU) cross sections and total dose hardness of commercially available MIPS R3000 microprocessors (CPU) and R3010 floating point units (FPU) were obtained by exposing these parts to 256 MeV protons from the linear accelerator (LINAC) at the Los Alamos Meson Physics Facility (LAMPF). Parts from several manufacturers were tested. The CPUs and FPUs were tested dynamically during radiation exposure with specially designed assembly language codes which exercised a subset of the available instructions in order to simulate the actual operation of each part. Cross sections derived from the SEU data were used to calculate expected upset rate for a 500-km orbit during quiet solar conditions, the King 1972 solar flare, and the August 4, 1972, event modeled by Adams et al. 16 refs., 16 figs., 3 tabs.

## 4404 Well Logging Instrumentation

*Refer also to citation(s) 33647, 33785, 33809, 33914*

## 4405 Thermal Instrumentation

*Refer also to citation(s) 34038*

**34953** (LA–12129-MS) **A 2-D imaging heat-flux gauge.** Noel, B.W. (Los Alamos National Lab., NM (United States)); Borella, H.M.; Beshears, D.L.; Sartory, W.K.; Tobin, K.W.; Williams, R.K.; Turley, W.D. Lawrence Berkeley Lab., CA (United States). Jul 1991. 84p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE92000153. Source: OSTI; NTIS; GPO Dep.

This report describes a new leadless two-dimensional imaging optical heat-flux gauge. The gauge is made by depositing arrays of thermorgraphic-phosphor (TP) spots onto the faces of a polymethylpentene is insulator. In the first section of the report, we describe several gauge configurations and their prototype realizations. A satisfactory configuration is an array of right triangles on each face that overlay to form squares when the gauge is viewed normal to the surface. The next section of the report treats the thermal conductivity of TPs. We set up an experiment using a comparative longitudinal heat-flow apparatus to measure the previously unknown thermal conductivity of these materials. The thermal conductivity of one TP, $Y_2O_3$:Eu, is 0.0137 W/cm·K over the temperature range from about 300 to 360 K. The theories underlying the time response of TP gauges and the imaging characteristics are discussed in the next section. Then we discuss several laboratory experiments to (1) demonstrate that the TP heat-flux gauge can be used in imaging applications; (2) obtain a quantum yield that enumerates what typical optical output signal amplitudes can be obtained from TP heat-flux gauges; and (3) determine whether LANL-designed intensified video cameras have sufficient sensitivity to acquire images from the heat-flux gauges. We obtained positive results from all the measurements. Throughout the text, we note limitations, areas where improvements are needed, and where further research is necessary. 12 refs., 25 figs., 4 tabs.

**34954** (Y/TR–90/16) **Thermodilatometer using microwaves.** Karmazsin, E. (Centre National de la Recherche Scientifique (France)). Oak Ridge Y-12 Plant, TN (United States). [1990]. 16p. Translation of French Patent 2,565,348. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OS21400. Order Number DE91018484. Source: OSTI; NTIS; GPO Dep.

The purpose of the invention is to propose a novel thermodilatometer which takes up little space, is robust and easy to use. To reach the above objectives, the purpose of the invention is characterized in that it consists of: a wave guide which forms an application cavity, a microwave generator, with power which can be regulated, adapted to one of the transverse extremities of the wave guide, a dilatometer which is carried by the wave guide and which consists of: a silica support column for a specimen, which extends perpendicularly to the direction of propagation of the electric field inside the cavity, and a stress silica push rod carried by the column and connected to a sensor by a transmission assembly, and means to measure, by direct contact, the temperature inside the cavity. 4 figs.

## 4406 Optical Instrumentation

*Refer also to citation(s) 33585*

**34955** (CONF-9108153–1) **Progress in photon scanning-tunneling microscopy (PSTM).** Ferrell, T.L.; Sharp, S.L.; Warmack, R.J. Oak Ridge National Lab., TN (United States). [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 1991 scanning tunneling microscopy; Interlaken (Switzerland); 12-16 Aug 1991. Order Number DE91018174. Source: OSTI; NTIS; GPO Dep.

Tunneling of either electrons or photons from a sample to a probe tip yields an exponential signal that permits subwavelength tangential resolution and even better resolution of the tip-to-sample distance. Photon Scanning Tunneling Microscopy (PSTM) provides images of both insulators and conductors that are either thin or not too strongly absorbing at the wavelength used. Scanning Tunneling Microscopy (STM) provides better spatial resolution but poorer spectroscopic resolution, so there are complementary aspects for the two instruments. Our recent progress with the PSTM includes adding a zoom capability, detection of surface-enhanced Raman signals, imaging of photolithographically prepared arrays of isolated silver particles, and studies of tunneling effects on films of photoresist. 7 refs., 11 figs.

**34956** (DOE/ER/61058–1) **[Development of high spectral resolution lidar technology]: Technical progress summary.** Eloranta, E.W. Wisconsin Univ., Madison, WI (United States). Space Science and Engineering Center. 30 Jul 1991. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61058. Order Number DE92000080. Source: OSTI; NTIS; GPO Dep.

The first year of this grant has been devoted to the design and construction of an upgraded version of the University of Wisconsin High Spectral Resolution Lidar (HSRL). The new system incorporates additional data channels to measure depolarization and multiple scattering in the lidar return. Schematic diagrams describing the new configurations are attached to this report. Increases in optical efficiency and receiver aperture, coupled with improvements in the stiffness and the thermal stability of the mechanical system are expected to significantly improve the performance of the instrument. Most components of the system are nearly completed and system integration is about to begin. The HSRL is committed to participate in the NASA FIRE cirrus experiment during November and December of this year. Our progress is completing HSRL subsystems is outlined in the following paragraphs. 3 figs.

**34957** (SAND–91-2046C) **Design and testing of space-domain minimum average correlation energy (SMACE) filters for 2-D acousto-optic correlators.** Connelly, J.M. (Carnegie-Mellon Univ., Pittsburgh, PA (United States)); Vijaya Kumar, B.V.K.; Molley, P.A.; Stalker, K.T.; Kast, B.A. Sandia National Labs., Albuquerque, NM (United States). [1991]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9107115–48: Society of Photo-Optical Instrumentation Engineers (SPIE) meeting, San Diego, CA (United States), 21-26 Jul 1991). Order Number DE91019062. Source: OSTI; NTIS; GPO Dep.

Two-dimensional Acousto-optic (AO) correlators differ from the frequency plane correlators in that multiplying, shifting, and adding, rather than Fourier transforming are used to obtain the correlations. Thus, many of the available composite filter design techniques are not aimed at designing filters for use in AO correlators since they yield frequency-domain functions. In this paper, a method is introduced for designing filter impulse responses of arbitrary extents for implementation on AO correlators. These filters are designed to yield sharp correlation peaks. Simulation results are included to illustrate the viability of the proposed approach. Also included are some initial results from the first successful use of grey-level composite filters on an AO correlator. 12 refs,. 14 figs., 3 tabs.

**34958** (SAND–91-2047C) **Design and testing of 3-level optimal correlation filters.** Hendrix, C. (Carnegie-Mellon Univ., Pittsburgh, PA (United States). Dept. of Electrical and Computer Engineering); Vijaya Kumar, B.V.K.; Stalker, K.T.; Kast, B.; Shori, R. Sandia National Labs., Albuquerque, NM (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9107115–49: Society of Photo-Optical Instrumentation Engineers (SPIE) meeting, San Diego, CA (United States), 21-26 Jul 1991). Order Number DE91019059. Source: OSTI; NTIS; GPO Dep.

Previously, we have designed 3-level filters (suitable for implementation on magneto-optic spatial light modulators) to maximize the output signal-to-noise ratio (SNR) and to separately maximize Peak-to-Correlation Energy (PCE) that measures the correlation peak sharpness. In practice, we want the correlation peaks to be sharp (i.e., large PCE) as well as noise-tolerant (i.e., large SNR). In this paper, we will present a new method to optimally combine these two desirable properties into a single optimization procedure. Similar methods to trade off SRN versus Peak Efficiency and PCE versus Peak Efficiency will be presented. Both simulation and experimental results will be included. 7 refs., 10 figs.

**34959** (UCRL-CR–107134) **Fast Optically Sensitive Segmented Array (FOSSA): Final report.** Lawrence Livermore National Lab., CA (United States); Eastman Kodak Co., Rochester, NY (United States). 31 Jan 1991. 116p. Sponsored by USDOE,

Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018997. Source: OSTI; NTIS; GPO Dep.

R1 image sensors were designed, fabricated, and partially tested. Most testing of the image area was precluded due to a clocking problem with the vertical CCDs. The probable cause of this clocking problem was due to inadequate contact to the p-well regions inside the image area. Since this time, we have successfully operated devices with the same readout architecture fabricated using a similar process. However, many of the other device design goals were met for this program. The photodiodes, antiblooming structure, and horizontal shift registers were seen to be functional. 5 refs., 14 figs., 6 tabs.

**34960** (UCRL-JC-106888) **Stray light reduction in a WFOV star tracker lens.** Lewis, I.T.; Ledebuhr, A.G.; Axelrod, T.S.; Ruddell, S.A. Lawrence Livermore National Lab., CA (United States). 23 Jul 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9107115–46: Society of Photo-Optical Instrumentation Engineers (SPIE) meeting, San Diego, CA (United States), 21-26 Jul 1991). Order Number DE91018460. Source: OSTI; NTIS; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) has recently developed a wide-field-of-view (28° x 44°) camera for use as a star tracker navigational sensor. As for all seasons, stray light rejection performance is critical. Due to the baffle dimensions dictated by the large field angles, the 2-part sunshade/baffle configuration commonly seen on space-born telescopes is impractical. Meeting the required stray light rejection performance (of $10^{-7}$ Point Source Transmittance, (PST)) with a 1-part baffle required iterative APART modeling (APART is an industry standard stray light evaluation program), hardware testing, and mechanical design correction. This paper presents a chronology of lens and baffle improvements that resulted in the meeting of the stray light rejection goal outside the solar exclusion angle of the baffle stage. Comparisons with APART analyses are given, and future improvements in mechanical design are discussed. Stray light testing methods and associated experimental difficulties are presented. 12 figs.

## 4407 Geophysical and Meteorological Instrumentation

**34961** (USGS-OFR-90-37) **Geologic mapping of tunnels using photogrammetry-control-point configuration.** Coe, J.A. (Geological Survey, Denver, CO (United States)); Dueholm, K.S. Geological Survey, Denver, CO (United States). 1991. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AI08-78ET44802. Order Number DE91019071. Source: OSTI; NTIS; GPO Dep.

A photogrammetric method has been developed by the US Geological Survey and the US Bureau of Reclamation for use in geologic mapping of tunnels (drifts). The method requires photographing the tunnel walls and roof with a calibrated small-format camera to obtain stereo pairs of photos which are then oriented in an analytical stereo plotter for measurement of geologic features. The accuracy of the mapping depends, in part, on the control configuration used to orient the photos. Accuracy experimentation using a block of 16 small-frame-stereoscopic models was performed. Systematic control configurations were tested, using bundle adjustment calculations, to determine the effect on the absolute accuracy of point measurements in oriented blocks of photos. Surveyed targets and camera-station coordinates were used as control. Fifteen control targets produced reliable and robust-orientation results with RMS coordinate errors less than 3.0 mm. Four control targets, combined with 20 camera stations, produced equally good results. 3 refs., 6 figs., 1 tab.

## 4408 Miscellaneous Instrumentation

*Refer also to citation(s) 33817, 33964, 34783, 34788, 34832, 34954*

**34962** (CONF-9108160–1) **New dimensions in atom probe analysis.** Cerezo, A. (Oxford Univ. (United Kingdom). Dept. of Materials); Hyde, J.M.; Beverini, G.; Setna, R.P.; Warren, P.J.; Smith, G.D.W.; Miller, M.K. Oak Ridge National Lab., TN (United States). [1991]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 38. international field emission symposium: Vienna (Austria): 5-9 Aug 1991. Order Number DE91018926. Source: OSTI; NTIS; GPO Dep.

A new class of atom probe instruments has recently been developed which combine single atom sensitivity mass spectrometry with position sensing, and have the potential of reconstructing nanometre-scale composition variations in 3-dimensions. These techniques will be very powerful in the study of the early stages of phase transformations, and surface and interface segregation. Some recent results obtained with the first of the instruments, the position-sensitive atom probe, are described. Difficulties arise in this instrument when more than one ion is evaporated from the analysis area on a single field evaporation pulse, which can limit the accuracy of analysis performed on the resultant data. Other 3-dimensional atom probe instruments currently under development are described, and their expected performance in this respect is discussed. The significance of defining composition on the sub-nanometre scale is addressed, and the importance of atomic-scale modelling of the phenomena under investigation is indicated. 30 refs., 8 figs.

**34963** (DOE/ER/61060–1) **Ground-based millimeter wave cloud profiling radar system (CPRS): Technical progress report.** McIntosh, R.E.; Pazmany, A.L.; Mead, J.B. Massachusetts Univ., Amherst, MA (United States). Microwave Remote Sensing Lab. Aug 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61060. Order Number DE91018373. Source: OSTI; NTIS; GPO Dep.

The proposed Cloud Profiling Radar System (CPRS) is a two frequency (35 GHz, 95 GHz) polarimetric radar with a single reflector-lens antenna. The system will be used to perform three dimensional Doppler and polarimetric measurements on clouds. The various subsystems are currently being developed and this report gives technical details about the status of these subsystems. This report also updates other research activities. 7 figs.

**34964** (DOE/METC–89/6105, pp. 339-345) **Development of on-stream instrumentation for the characterization of fossil-energy derived process streams.** Wachter, J.K. USDOE Morgantown Energy Technology Center, WV (United States). May 1989. (CONF-890572–: 1. annual fuel cells contractors review meeting, Morgantown, WV (United States), 2-4 May 1989). In *Proceedings of the first annual fuel cells contractors review meeting.* 386p. Order Number DE89011699. Source: OSTI; NTIS.

Unique on-line instrumentation is being developed at the Morgantown Energy Technology Center (METC) for the enhanced chemical and physical analysis of high-temperature/high-pressure process streams generated by advanced fossil-energy conversion and utilization systems. Overall, the advanced instrumentation being developed will have advantages over conventional (off-line) instrumentation in its abilities to deliver real-time chemical data and to make measurements at or near process stream conditions (which tends to eliminate artifact and contaminant problems typically encountered during off-line analysis). Also, in situ analysis is possible using some of the instrumentation being developed, which affords the scientist the opportunity to possibly assess reaction mechanisms within the process pipe. The primary components which are to be identified and quantitated using this instrumentation include: major and trace elements, sulfur gas species, certain nitrogen gas species, and particles.

**34965** (DOE/PC/90306–T1) **A rheometer for measuring the material moduli for granular solids: Second quarterly progress report.** Rajagopal, K.R. Pittsburgh Univ., PA (United States). Dept. of Mechanical Engineering. 15 Jul 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG22-90PC90306. Order Number DE91018364. Source: OSTI; NTIS; GPO Dep.

In this quarterly report, we discuss the progress that has been made with regard to our research on an experimental method for characterizing the material properties of granular solids. In the previous report we have discussed the various aspects of selecting a particular component for the instrument we have proposed to build. Keeping these various aspects in mind, we have selected and ordered these components. Some of the parts are being fabricated in the workshop while others have been ordered. While some of the orders have been delivered others are yet to come. We are in the

process of putting the equipment together. However, since the load-cells and some other crucial parts have not been delivered, this will have to wait. 1 ref., 1 fig.

**34966** (EGG-CS–9762) **Instrumental design for measurement of surface charge on insulating materials.** Beck, S.T. EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1991. 144p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018695. Source: OSTI; NTIS; GPO Dep.

The study of electric charge buildup on nonconducting samples requires additional research and development in an attempt to gain knowledge of its behavior. One area affected by charge buildup is the charged particle spectroscopies, specifically, secondary ion mass spectroscopy (SIMS). In SIMS, a sample is bombarded with a primary particle beam that results in secondary ions being displaced from the sample's surface. The secondary ions are focused into the mass spectrometer where they are "filtered" out with respect to their individual atomic masses. When the sample is an insulating material, sample charging eventually occurs due to an imbalance of charged particles leaving the surface. The generated surface charge has severe consequences on the SIMS instrument's ability to perform an analysis. An instrument has been designed and constructed that studies the behavior of charge buildup on insulating materials in an attempt to uncover superior methods that will alleviate its effects in SIMS and other surface analysis techniques. The instrument uses two ion beams; one to apply charge to the sample and the second to determine the voltage located on the surface of the sample. As charge is generated on the sample, a positive cesium ion beam passes parallel to the surface and is deflected by the electrostatic potential on the sample. The cesium beam deflects a specific direction and magnitude, depending on the polarity and magnitude of the sample charge. The displacement of the beam is monitored with the aid of a microchannel plate and photodiode array combination. Experiments performed show that the instrument has a sensitivity of 0.05 volts and an uncertainty drift of 1.5 volts over a 2 hour period. Mylar surface charging data illustrates that the sample voltage is highly dependent on the magnitude and polarity of voltage gradients surrounding the sample. 52 refs., 28 figs., 4 tabs.

**34967** (IS-T–1514) **Development of instrumentation for magnetic nondestructive evaluation.** Hariharan, S. Ames Lab., IA (United States). 23 Sep 1991. 118p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE92000152. Source: OSTI; NTIS; GPO Dep.

The use of failure-prone components in critical applications has been traditionally governed by removing such components from service prior to the expiration of their predicted life expectancy. Such early retirement of materials does not guarantee that a particular sample will not fail in actual usage. The increasing cost of such life expectancy based operation and increased demand for improved reliability in industrial settings has necessitated an alternate form of quality control. Modern applications employ nondestructive evaluation (NDE), also known as nondestructive testing (NDT), as a means of monitoring the levels and growth of defects in a material throughout its operational life. This thesis describes the modifications made to existing instrumentation used for magnetic measurements at the Center for Nondestructive Evaluation at Iowa State University. Development of a new portable instrument is also given. An overview of the structure and operation of this instrumentation is presented. This thesis discusses the application of the magnetic hysteresis and Barkhausen measurement techniques, described in Sections 1.3.1 and 1.3.2 respectively, to a number of ferromagnetic specimens. Specifically, measurements were made on a number of railroad steel specimens for fatigue characterization, and on specimens of Damascus steel and Terfenol-D for materials evaluation. 60 refs., 51 figs., 5 tabs.

**34968** (Juel–2424) **Investigations of the realization of a laser ionization mass spectrometer on the basis of a MAT-SM1B device.** Heimbach, H. Forschungszentrum Juelich GmbH (Germany). Zentralabteilung fuer Chemische Analysen. Jan 1991. 61p. (In German). Order Number DE92711333. Source: OSTI; NTIS (US Sales Only).

Bulk analysis of ceramics and other non-conducting materials with a laser ionisation mass spectrometer offers the advantage of minimum sample treatment and short analysis time. Such an instrument can be constructed by coupling a laser to the ion source of a double focussing mass spectrometer. In this report the conversion of a spark-source MAT-SM1B instrument to a laser-ionisation mass spectrometer will be described, with special emphasis on sample handling, ion optics and improvement of ion transmission. The results of measurements on various samples clearly demonstrate that nearly any material can be analysed qualitatively. Due to the poor reproducibility of the ionisation condition quantification will only be possible in favourable cases. Using a Nd/YAG laser with a high repetition rate (700 Hz) and recording the spectra on photoplates a detection limit of 80 ppm(w) was measured. (orig.).

**34969** (SAND–91-1865) **Sandia severe electrostatic discharge tester: Version 3 (SSET), Serial Number: 1: Verification report Issue A.** Barnum, J.R. Sandia National Labs., Albuquerque, NM (United States). 31 Jul 1991. 48p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91018582. Source: OSTI; NTIS; GPO Dep.

This report documents the as-built operational performance of Sandia's Severe Electrostatic Discharge Tester Version-3 (SSET-3) SN:2 and lists the hardware and additional documentation delivered to Division 2174 on July 31, 1991. (The supplied items are listed.) The primary emphasis of this report is to provide a qualitative and quantitative evaluation of the SSET against requirements derived from the Severe Human Body ESD model (SHBESD) [1], which is defined in terms of an equivalent circuit (Figure 1.1) and a short-circuit current waveform (Figure 1.2). This report also presents supporting information on the calibration and verification of ancillary equipment used to assess the operation of the SSET. While the documentation of the verification and calibration of ancillary equipment is somewhat lengthy, it is considered necessary because the SSET may be used in situations where its output characteristics will be critically scrutinized. Thus, the supporting documentation is necessary to lend credibility to the performance/verification measurements made on the SSET. 5 refs., 36 figs.

## 45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

*Refer also to citation(s) 33750, 34225, 34244, 35516*

**34970** (ORNL/CSD/TM–269/R1) **Scheduling algorithm for improving lift (SAIL): Documentation revision - August 1991.** Hawthorne, J.E.; McLaren, R.A. Oak Ridge National Lab., TN (United States). Aug 1991. 222p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000413. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Military Sealift Command, a component of the United States Transportation Command, is responsible for the sealift of military personnel and material during a crisis. Conceptual plans for these complex moves, called deliberate plans, are continuously being prepared. A computer-based scheduling system, the Sealift Strategic Analysis Subsystem (SEASTRAT), is under development for assisting in the production of these plans. The ship scheduling portion of this system, the Scheduling Algorithm for Improving Lift (SAIL), combines linear optimization and heuristic methods to determine ship routes and cargo loadings which honor a variety of complex operational constraints. 15 refs., 4 figs., 12 tabs.

**34971** (ORNL/TM–11680) **Analysis of military occupational specialty in Army National Guard units.** Rizy, C.G.; Bjornstad, D.J.; Vogt, D.P. Oak Ridge National Lab., TN (United States). Aug 1991. 99p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000411. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The concept of Army National Guard (ARNG) unit supportability is multifaceted, involving several areas: defining criteria that distinguish a successful unit; determining the military available population within a market area that could be persuaded to enlist in a unit; evaluating specific unit types, in terms of military occupational

specialties (MOS) mix, and the availability of persons within the market area to fill those positions; and investigating the female market for recruiting. Each of these aspects is addressed in a separate task of this project. This paper concerns the third issue just mentioned, namely, the supportability of specific unit types and the market constraints that may exist, which could encumber a unit's supportability. The results of our analysis led to three major conclusions. Generally, it appears that people can be trained to fill a position and that they need not possess special abilities or skills in their civilian occupations in order to fill a position. Thus, in the majority of cases, the issue of unit supportability depends on an adequate labor supply from which to recruit in terms of the number of people and does not depend on the availability of a specialized labor force. The third conclusion is that the availability of a labor supply with the skills and/or abilities associated with broad occupational categories may be useful. These conclusions are valuable from the modeling perspective for two reasons. First, in most cases, the supportability issue does not require detailed employment information matched with MOS characteristics. Secondly, in some instances, the distribution of labor by broad employment categories may be useful. This eliminates the need for detailed occupational data, but suggests that there is an advantage to incorporating general information about the mix of the local labor market. 4 refs., 25 tabs.

**34972** (PNL-SA-19432) **Commander's critical information requirements and how to determine them.** Hesser, W.A. (Pacific Northwest Lab., Fort Lewis, WA (United States). ATCCS Experimentation Site). Pacific Northwest Lab., Richland, WA (United States). Jun 1991. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9106230--2: 59. Military Operations Research Society (MORS) symposium, West Point, NY (United States), 11-13 Jun 1991). Order Number DE91018471. Source: OSTI; NTIS; GPO Dep.

The US Army has been interested for some time in determining what information was critical for its tactical commanders and their staffs for two reasons. First the Army is interested in the decision-making process in and of itself and anything that could provide insight to that process. Second, with the introduction of automated systems into tactical operations centers, developers need a way to prioritize the information to be provided by those systems to the commander and the staff. The Army Tactical Command and Control System Experimentation Site (AES) at Fort Lewis, Washington, has spent almost three years conducting experiments into the functioning and effectiveness of command and control systems. Part of the research has been into commanders critical information requirements (CCIR) and staff critical information requirements (CIR). Three large research efforts, Force Level Control System (FLCS) experiments 1, 2, and 3 were conducted in 1989 and 1990. The first two examined CCIR at the brigade level; the latter determined CCIR and CIR for intelligence functions at the division. This paper presents some of the methods employed in the research and includes sample results showing the range and depth of the analysis. 4 refs., 9 tabs.

**34973** (SAND-91-2189C) **Terrain referenced navigation for cruise missiles.** Hollowell, J. Sandia National Labs., Albuquerque, NM (United States). [1991]. 44p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9111100--1: 1991 cruise missiles technology symposium (CMTS), Laurel, MD (United States), 7 Nov 1991). Order Number DE92000228. Source: OSTI; NTIS (US Sales Only); GPO Dep.

GPS receivers provide absolute position accuracy that is more than adequate for enroute navigation on cruise missiles. However, their vulnerability to outside threats provides the impetus for considering other navigation aids. The TERCOM[1] Terrain Referenced Navigation (TRN) system provides self-contained navigation for existing cruise missiles. One significant problem with the existing TERCOM system is its stringent mission planning requirements. The digitized maps used by the system must be carefully selected and checked prior to the mission. Additionally, route planning is severely constrained since the missile must fly over the preselected maps. Defense Mapping Agency (DMA) Level 1 Digital Terrain Elevation Data (DTED) is available for a large portion of the Earth's landmass. Use of this database may drastically reduce TRN mission planning requirements since the map selection process is avoided and route planning becomes much more flexible. Two tasks were performed in support of this goal. First, a large portion of the existing database of Level 1 DTED was screened based on certain terrain parameters that provide some a priori indication of how a TRN system would perform over a given area of the Earth. Secondly, flight tests were conducted to determine the actual performance of a TRN algorithm over a representative sample of Level 1 DTED. The results and conclusions from these two tasks follow. 4 refs., 29 figs., 2 tabs.

**34974** (UCID-20622-91-1) **Chemistry and Materials Science research report.** Lawrence Livermore National Lab., CA (United States). Aug 1991. 84p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018655. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The research reported here in summary form was conducted during the first half of FY 91 under the auspices of Weapons-Supporting Research (WSR) and Laboratory Directed Research and Development (LDRD). Main areas of interest are plutonium, physics and processing of metals, adhesion and bonding of interfaces, energetic materials, synchrotron-radiation-based materials science, and tritium. Other topics included are surface properties of materials, aerogels,ion implantation, point defects in fluorides, and properties of magnetic films. (GHH)

## 4501 Chemical Explosions and Explosives

*Refer also to citation(s) 34573, 34980, 34981*

**34975** (ALS/TR-91-006) **Chemical analysis of trace substances from explosives.** Lakso, H.A. (Defense Research Establishment, Umea (Sweden)). Sandia National Labs., Albuquerque, NM (United States); Foersvarets Forskningsanstalt, Umeaa (Sweden). Apr 1991. 26p. Translation of FOA Report C 40274-8.2(May 1990). Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91017833. Source: OSTI; NTIS; GPO Dep.

This report describes the work on "Mine Detection through Air Analysis" carried out during 1988--89. The objective of this work was to determine whether explosives contained in mines release such amounts of gaseous organic substances that they can be detected with the available technology (gas chromatography with selective detectors). In the first place we wished to investigate surface mines, with below-ground mines to be investigated at a later stage. Since explosives contained in mines release small amount of gas, which continuously expand in the surrounding atmosphere, an extremely sensitive measurement method was needed. The method selected consisted of a sampling part and an analysis part. Sampling was performed with the help of adsorbent tubes, i.e., glass tubes filled with a porous polymer, on the surface of which the gas would concentrate when air was passed through the tube. After sampling, the substances concentrated on the adsorbent were determined via so-called thermal desorption and gas chromatographic analysis. A number of laboratory tests were performed, in which the amount of explosive-related gas was determined for a few explosives and the impurities they contain. During the spring of 1989 field testing was also carried out, in which live mines were put in place and the air surrounding the "mine field" was sampled. 4 refs., 6 tabs.

**34976** (SAND-90-1906) **Development of a non-propagating explosives storage cabinet.** Couch, W.A. (Sandia National Labs., Albuquerque, NM (United States)); Schneider, B.A. Sandia National Labs., Albuquerque, NM (United States). Aug 1991. 73p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91017923. Source: OSTI; NTIS; GPO Dep.

Sandia National Laboratories, Albuquerque (SNL) has completed the design of an Explosive Components Facility (ECF). Construction of the ECF is scheduled to begin in 1992 with completion in 1995. An integral part of the ECF will be on-site storage of explosives in six earth-covered service magazines. Each magazine will contain a non-propagating Explosives Storage Cabinet (ESC) system made up to twenty modular units. In addition to the secure

storage of explosives, a primary purpose of the cabinet system is to prevent a sympathetic detonation of the explosives stored in the surrounding units as a result of an accidental detonation of up to 5.0 pounds of explosives (TNT equivalent) stored in a "donor" unit in the cabinet. Therefore, the "maximum creditable event" for each service magazine is 5.0 pounds, even though each magazine could contain up to 100 pounds of explosives stored in 5.0 pounds increments. A new material being developed at the New Mexico Engineering Research Institute (NMERI) known as SIFCON (Slurry Infiltrated Fiber CONcrete), had been shown to be highly resistant to back spall from blast loadings, and penetration by high-velocity ballistic projectiles and fragments. These, and other characteristics unique to SIFCON, such as very high strength and ductility, appeared to make it an excellent candidate material for the modular units of the ESC. In 1989 SNL contracted with NMERI to develop a SIFCON modular unit for the ESC. Based upon the success of Phase 1 program, a more extensive Phase 2 program was undertaken in 1990 and has been successfully completed. This paper is a summary of the Phase 1 and Phase 2 work, which includes the design, fabrication, and explosive testing of the modular units.

**34977** (SAND–91-0364C) **Determination of the contact forces between a projectile and a hard target.** Thomas, R.K.; Bateman, V.I.; Carne, T.G. Sandia National Labs., Albuquerque, NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911195–1: Army symposium on solid mechanics: synergism of mechanics, mathematics and materials, Plymouth, MA (United States), 4-7 Nov 1991). Order Number DE91018354. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The determination of the contact forces at impact between a deformable projectile and a hard target is required for the design of energy absorbing features which limit shock loads experienced by critical onboard components carried by the projectile. In this paper we present both analytical and experimental methods to obtain the force-displacement history of the impact event. The immediate application of these methods is toward the design of energy absorbing noses for laydown bombs. Upon impact, the desired performance of the deformable nose is to absorb the kinetic energy of the laydown bomb and smoothly decelerate the motion to near-zero velocity. This attenuates the shock loads to internal electronic components which must function after the impact event. The example we have chosen is the axial impact of a 670 lb projectile, traveling at a velocity of 125 ft/sec, onto a hard concrete target. In general, this technology falls within the area of crash worthiness, and thus has further application to transportation vehicles and shipping containers. 6 refs., 5 figs.

**34978** (UCRL-JC–108312) **Compatibility of Halthane 88-3 urethane adhesive with the replacement cleaning solvent D-Limonene.** LeMay, J.D.; Mendoza, B. Lawrence Livermore National Lab., CA (United States). Aug 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9110172–4: 17. DOE compatibility and aging and service life conference, Golden, CO (United States), 1-3 Oct 1991). Order Number DE92000490. Source: OSTI; NTIS; GPO Dep.

D-Limonene, (R)1-methyl-4-isopropenyl-1-cyclohexene, has been identified as a leading replacement for chlorinated solvents traditionally used to clean electrical assemblies and critical components in some phases of weapons production. Unfortunately, d-limonene has a much lower vapor pressure than the chlorinated solvents if replaces (<2 torr at ambient). This makes its complete elimination from cleaned subassemblies potentially difficult, and gives rise to concerns about the compatibility of d-limonene with materials in the warhead. During the past year many WR polymers and adhesives have been surveyed for their compatibility with d-limonene. Preliminary test results obtained at Sandia (Albuquerque) and Allied-Signal (KCD) showed that Aluminum/Halthane 88-3/Aluminum joints were destroyed during exposure to saturated d-limonene vapor. The cause of bond failure appeared to be d-limonene induced swelling of the Halthane polymer. This report describes recent work performed at LLNL to study the swelling behavior and bond strength degradation of Halthane 88-3 resulting from exposure to d-limonene vapor.

## 4502 Nuclear Explosions and Explosives

*Refer also to citation(s) 34977, 34981, 35003, 35030, 35031, 35037, 35044, 35455*

**34979** (LA-UR–91-2971) **Discrete event simulation in an artificial intelligence environment: Some examples.** Roberts, D.J.; Farish, T. Los Alamos National Lab., NM (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109110–8: International conference on frontiers in innovative computing for the nuclear industry, Jackson, WY (United States), 15-18 Sep 1991). Order Number DE92000218. Source: OSTI; NTIS; INIS; GPO Dep.

Several Los Alamos National Laboratory (LANL) object-oriented discrete-event simulation efforts have been completed during the past three years. One of these systems has been put into production and has a growing customer base. Another (started two years earlier than the first project) was completed but has not yet been used. This paper will describe these simulation projects. Factors which were pertinent to the success of the one project, and to the failure of the second project will be discussed (success will be measured as the extent to which the simulation model was used as originally intended). 5 figs.

**34980** (UCRL-JC–107941) **The explosion seismic source function: Models and scaling laws reviewed.** Denny, M.D. (Lawrence Livermore National Lab., CA (United States)); Johnson, L.R. Lawrence Livermore National Lab., CA (United States). 6 Aug 1991. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-890398–1: DOE/LLNL symposium on explosion-source phenomenology, Lake Tahoe, CA (United States), 14-16 Mar 1989). Order Number DE91018725. Source: OSTI; NTIS; GPO Dep.

The explosion seismic source function is the potential which satisfies the spherical P-wave equation. It is completely described by four properties. They are the steady-state value, roll-off, overshoot, and corner frequency. In one approach to describing the potential, the spectral roll-off is specified and the other properties are determined by fitting the data at prescribed times. In a variation of this approach, the roll-off is specified by assuming a radial stress of a known form is applied uniformly over a spherical surface, located at a range where the motion is assumed to be linear. In this review, it was found that of the four properties, less uncertainty exists about the steady-state value and the corner frequency than about the other two. A major problem has been scaling the results from one yield to another. New results are presented that show that, when the geophysical properties of the shot point are taken in account, cube-root scaling of the yield is appropriate for the steady-state value and the corner frequency, i.e., yield to the first and one-third powers, respectively. The new results also suggest that previous assumptions about the form of the applied radial stress are probably not appropriate. Finally, chemical and nuclear explosions appear in the new results to be indistinguishable, suggesting that experiments using chemical explosions could aid in reducing the remaining uncertainty in the seismic source function properties. 93 refs., 15 figs.

## 4503 Nuclear Explosion Detection

**34981** (CONF-9109114–Absts.) **Sixth symposium on containment of underground nuclear explosions: Abstracts.** Lawrence Livermore National Lab., CA (United States). [1991]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. From 6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991. Order Number DE91018719. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This volume contains the abstracts for the papers being presented at the Sixth Symposium on the Containment of Underground Nuclear Explosions, September 24–27, 1991. The Sixth Symposium is intended to be a meeting of personnel from all levels in the containment community. Presentations and discussions on containment and related geological, geophysical, engineering, chemical, and computational topics are included. In addition to the

formal presentations, the meeting is designed to foster an exchange of ideas and information. We hope that all attendees will be active participants. The Symposium is being held at the Lawlor Events Center on the campus of the University of Nevada in Reno. The Desert Research Institute is hosting the meeting, and special thanks are due to Barbara Salmon of DRI for her help in arranging the meeting. The meeting has been coordinated jointly by representatives of the Lawrence Livermore National Laboratory, the Los Alamos National Laboratory, and the Nevada Operations Office of the US Department of Energy. Although the abstracts are unclassified, the meeting is classified, and an active security clearance is required to attend. Proceedings of the Symposium will be published as soon as possible after the meeting.

**34982** (UCRL-ID–107485) **The HYIELD hydrodynamic yield analysis code.** Heinle, R.A.; Goldwire, H.C. Jr. Lawrence Livermore National Lab., CA (United States). 17 Jun 1991. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018660. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This paper describes a computer program we use to analyze hydrodynamic shock-position-vs-time data to determine the yield of an underground nuclear explosion. HYIELD is an interactive program that we use to calculate estimates of hydrodynamic yield from emplacement-hole or satellite-hole shock radius-vs-time data. It performs both strong shock algorithmic and similar explosion scaling analyses and can solve for the center of energy of an explosion along with the yield, that is, solve for any combination of yield, horizontal offset, or vertical offset. Nonvarying parameters are held fixed at known input values. HYIELD uses a straightforward, nonlinear, least-square technique to find a best-fit solution. The HYIELD program is written in the FORTRAN 77 language and currently runs on a VAX minicomputer or IBM PC-compatible microcomputer. The analysis techniques we employed are described. We provide examples of the code's usage and an explanation of its graphical and printed output. This paper is not intended to be a user's guide to HYIELD; however, a short section of a typical terminal dialog is included in the Appendix to serve as an explanation of required inputs. 6 refs., 28 figs., 1 tab.

## 4505 Strategic Defense Initiative

**34983** (DOE/SF/16518–T2) **Development of a current collection loss management system for SDI homopolar power supplies: Annual progress report No. 1, September 30, 1986–September 30, 1987.** Hannan, W.F. III. Westinghouse Electric Corp., Pittsburgh, PA (United States). Research and Development Center. [1987]. 83p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-86SF16518. Order Number DE92000398. Source: OSTI; NTIS; GPO Dep.

High speed, high power density current collection systems have been identified as an enabling technology required to construct homopolar power supplies to meet SDI missions. This work is part of a three-year effort directed towards the analysis, experimental verification, and prototype construction of a current collection system designed to operated continuously at 2 kA/cm$^2$, at a rubbing speed of 200 m/s, and with acceptable losses in a space environment. To data, no system has achieved these conditions simultaneously. This is the annual report covering the first year period of performance on DOE contract DE-AC03-86SF16518. Major areas covered include design and construction of a cryogenically-cooled brush test rig, design of a high speed brush test rig, loss analysis of the current collection system, and an application study which defines the air core homopolar construction necessary to achieve the goal of 80–90 kW/kg generator power density. 15 figs.

**34984** (DOE/SF/16518–T3) **Development of a current collection loss management system for SDI homopolar power supplies: Annual progress report No. 2, September 30, 1987–December 31, 1989.** Brown, D.W. Westinghouse Electric Corp., Pittsburgh, PA (United States). Science and Technology Center. [1989]. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-86SF16518. Order Number DE92000399. Source: OSTI; NTIS; GPO Dep.

High speed, high power density current collection systems have been identified as an enabling technology required to construct homopolar power supplies to meet SDI missions. This work is part of a three-year effort directed towards the analysis, experimental verification, and prototype construction of a current collection system designed to operate continuously at 2 kA/cm$^2$, at a rubbing speed of 200 m/s, and with acceptable losses in a space environment. To data, no system has achieved these conditions simultaneously. This is the annual report covering the second year period of performance on DOE contract DE-AC03-86SF16518. Major areas covered include design, construction and operation of a cryogenically cooled brush test rig, design and construction of a high speed brush test rig, optimization study for homopolar machines, loss analysis of the current collection system, and an application study which defines the air-core homopolar construction necessary to achieve the goal of 80–90 kW/kg generator power density. 17 figs., 2 tabs.

## 4506 Chemical and Biological

**34985** (CONF-9109272–1) **Obstacles to large-scale biological terrorism.** Chester, C.V. Oak Ridge National Lab., TN (United States). Sep 1991. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Annual meeting of doctors for defense preparedness; Las Vegas, NV (United States); 22 Sep 1991. Order Number DE91018932. Source: OSTI; NTIS (US Sales Only); GPO Dep.

US interest in toxic weapons was sharply rekindled in 1990 by the Gulf War. The adversary, Iraq, had used chemical weapons against Iran in the Iran-Iraq War, and was rumored to be producing biological weapons. US troops in Saudi Arabia were issued gas masks and protective clothing and given immunization shots against anthrax and botulism toxin. Because the US-lead UN coalition immediately established air supremacy over Iraq and concentrated on bombing known or suspected chemical biological production and storage sites, Sadam Hussein, the Iraqi dictator did not use toxic weapons. Had he done so, the US would have had the legal right to retaliate with B-52 raids drenching military targets with mustard and nerve agent. Instead, Hussein called on muslims everywhere, and especially in the US, to conduct a holy war against the US with terrorist attacks on US population and property. However, the potential exists for a large-scale biological attack in the US stimulated and financed by a foreign government, by domestic or foreign dissidents. The events considered here are toward the upper end of a spectrum of possible toxic agent attacks against civilians. The spectrum ranges from individual psychotics contaminating foods or medicine with cyanide or staphylococcus bacteria, through government-ordered assassinations using exotic toxins, raids on cities with crude anthrax bombs to sophisticated spray attacks from low-flying cruise missiles using genetically-engineered hemorrhagic fever viruses in dry form. This paper considers the simplest and most destructive attack possible: using easily grown anthrax spores with great ruggedness and very high lethality disseminated as a line source aerosol upwind of population centers. 1 tab.

**34986** (CONF-9109273–1) **Strategic potential of biological weapons.** Chester, C.V. Oak Ridge National Lab., TN (United States). Sep 1991. 3p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From American Civil Defense Association (ACDA) annual meeting; Las Vegas, NV (United States); 25 Sep 1991. Order Number DE91018931. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Biological weapons are potentially as superior to chemical weapons in casualty production per unit weight as nuclear explosives are to chemical explosives–about $10^5$ times. However, to realize this superiority, it is required that disease-producing organisms that decay slowly if al all be disseminated efficiently as a 1-to 5-micron particle diameter aerosol which can be breathed by the target population. Furthermore, the toxic cloud is totally dependent on weather conditions (wind, sunlight, atmospheric stability) at the time of release for cloud movement and persistence. For this and other reasons (danger of infecting own troops, delay in tactical tempo by protective measures and need for decontamination) biological weapons have not found favor with most military commanders. There is now an international agreement signed by most

nations which prohibits their use. The US unilaterally renounced the possession, manufacture, and development of offensive biological weapons in 1969. In the period leading up to the Gulf War, Iraq, which had used chemical weapons against Iran threatened the use of chemical weapons against the UN alliance forces, and implied that it was capable of also using biological weapons. At the same time Saddam Hussein, the leader of Iraq, called for a holy war against the US and its allies and called for terrorist attacks against US targets by Iraqis living in the US. fortunately, no one responded, as far as we know. Biological weapons have the potential for inflicting tremendous casualties on civilian populations if deployed skillfully under good conditions. These include deployment at night in light but steady winds of the right amount of agent of the right particle size in a densely populated area. Casualties could approach those from a nuclear attack.

**34987** (EGG-MS–9726) **Laser acoustic technology demonstration and equipment field trails.** Rodriguez, J.G.; Tow, D.M. EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1991. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018759. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A fieldable, noncontacting, laser acoustic method to characterize chemical weapon (CW) containers has been demonstrated. The laser sensor detects the vibrational response of CW containers to acoustic excitation. Laboratory results demonstrated that the vibrational signatures are unique to the fill material of the munition containers. The field trials, at Tooele Utah Army Depot, demonstrated that this noncontacting inspection technique could identify distinctive vibrational signatures for various chemical and conventional agents in munitions containers in a nonlaboratory environment. 12 figs.

# 54 ENVIRONMENTAL SCIENCES

*Refer also to citation(s) 33819, 34055*

## 5401 Environmental Sciences, Atmospheric

*Refer also to citation(s) 33602, 33802, 33803, 33849, 33977, 33980, 33981, 34162, 34163, 34164, 34165, 34166, 34167, 34168, 34169, 34170, 34171, 34172, 34175, 34176, 34178, 34180, 34181, 34182, 34188, 34189, 34190, 34191, 34192, 34193, 34230, 34231, 34232, 34233, 34337, 34352, 34408, 34802, 35026, 35039, 35080, 35082, 35116, 35146, 35533*

**34988** (BNL–46549) **Modeling of water spraying of field releases of hydrogen fluoride.** Fthenakis, V.M. (Brookhaven National Lab., Upton, NY (United States)); Schatz, K.W.; Zakkay, V. Brookhaven National Lab., Upton, NY (United States). 14 Oct 1990. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-910530–2: International conference and workshop on modeling and mitigating the consequences of accidental releases of hazardous materials, New Orleans, LA (United States), 6-10 May 1991). Order Number DE92000126. Source: OSTI; NTIS; GPO Dep.

The effectiveness of water sprays to absorb HF releases has been recently demonstrated by extended laboratory and field tests. In this paper computer simulations are presented of the Hawk, Nevada Test Site, series of field tests, along with parametric studies of several cases which have not been studied in the field. The model used in these simulations, HFSPRAY, treats the gas-phase as an Eulerean fluid whereas the spray is described according to the Lagrangian approach by a finite number of drops of varying size and trajectory. HFSPRAY simulates the momentum, mass and energy interactions between a water spray and a turbulent plume of HF in air; it is capable of predicting the flow velocities, temperature, water vapor and HF concentration fields in two-dimensional large-geometries, for spraying in any direction, (i.e., down-flow, inclined-down-flow, up-flow, and co-current horizontal flow). 15 refs., 21 figs.

**34989** (BNL–46550) **Numerical simulations of turbulent flow fields caused by spraying of water on large releases of hydrogen fluoride.** Fthenakis, V.M. (Brookhaven National Lab., Upton, NY (United States)); Schatz, K.W. Brookhaven National Lab., Upton, NY (United States). May 1991. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-911213–9: American Society of Mechanical Engineers (ASME) annual winter meeting, Atlanta, GA (United States), 1-6 Dec 1991). Order Number DE92000127. Source: OSTI; NTIS; GPO Dep.

The effectiveness of water sprays in absorbing HF releases was recently demonstrated in extended laboratory and field tests. In this paper, computer simulations are presented of the Hawk, Nevada Test Site, series of field tests. The model used, HFSPRAY, is a Eulerean/Lagrangian model which simulates the momentum, mass and energy interactions between a water spray and a turbulent plume of HF in air; the model can predict the flow velocities, temperature, water vapor, and HF concentration fields in two-dimensional large- geometries for spraying in any direction, (i.e., down-flow, inclined-down-flow, up-flow, and co-current horizontal flow). The model was validated against recent data on spraying of water on large releases of HF. 17 refs., 11 figs., 4 tabs.

**34990** (CIEMAT–642) **Physico-chemical behaviour analysis of air pollutants in a complex coastal site: Castellon.** Andres, M.D.; Martin, M.; Plaza, J.; Millan, M. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1989. 50p. (In Spanish). Order Number DE92700003. Source: OSTI; NTIS (US Sales Only).

In Jaunary, July and August 1988 two experimental campaigns were launched in the surroundings of the Castellon industrial area located at the Spanish East coast and considered as a complex coastal site. The objetive was to complement the mosaic on mesoscale flows on the pollutants concentration fields. A careful study of pollutants concentration cycles related to meteorological parameters, enables the characterization of concentration patterns at the chose location. Surface atmospheric dynamic in this area in controlled by local cycles of NW nocturnal drainage and E-SSE diurnal sea-breeze flows. These cycles are also affected by the formation of thermal low over the center of the peninsula on summer days. Large scale synoptic conditions appear more frequently during the winter. A transportable laboratory was used to register ten minutes averaged values of $O_3$, NO, $NO_2$ and $SO_2$. This unit was placed in the zone of influence of the coastal industries during the sea-breeze regime. The temporal evolution of the pollutant concentrations was analyzed and shows the existence of repeated patterns of ground level concentrations under similar meteorological conditions. High ozone values have been detected to be associated with the sea-breeze onset. On the basis of short-term backward trajectories, it has been possible to identify the source of the $SO_2$ and $NO_2$ peaks. The obtained concentration values can have a broad origin: rural, marine, traffic, oil fired power plant and refinery emissions, and urban plume. Summer and winter data obtained under similar meteorological conditions have been compared. The temporal evolution of the pollutant concentrations is very similar. (Author)

**34991** (CIEMAT–669) **Differences of diurnal variations of some aliphatic and polycyclic aromatic hydrocarbons concentrations in aerosol of the urban area of Madrid.** Perez Garcia, M.M.; Perez Pastor, R.M.; Bea, J.F.; Campos, A.; Gonzalez Diaz, D. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1991. 27p. (In Spanish). Order Number DE92700009. Source: OSTI; NTIS (US Sales Only).

A study on daily concentration changes of polycyclic aromatic and aliphatic hydrocarbons (PAH's and AH's), was carried out in aerosols sampled in the Ciudad Universitaria of Madrid. Samples were taken at morning and night during February and June, for short sampling times, on glass fiber filters in Hi-Vol samplers, and then extracted ultrasonically with cyclohexane. Analysis were performed by HRGC with fused-silica capillary columns. The variable traffic rate, and the strong influence during winter periods of domestic heating are characteristic of this place. The aim of this work was to evaluate diurnal and seasonal variations of selected AH and PAH in the urban area of Madrid, by using descriptive parameters, such as total concentrations of AH and PAH, characteristic profiles and predominance carbon index. From these results, it has

been tried to identify emission sources of the studied hydrocarbons. (Author)

**34992** (CONF-910137–. pp. 63-80) **An evaluation of the effectiveness of the EPA comply code to demonstrate compliance with radionuclide emission standards at three manufacturing facilities.** Smith, L.R. (E.I. Du Pont de Nemours and Co., Billerica, MA (USA)); Laferriere, J.R.; Nagy, J.W. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society: Raleigh, NC (United States): 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Measurements of airborne radionuclide emissions and associated environmental concentrations were made at, and in the vicinity of, two urban and one suburban facility where radiolabeled chemicals for biomedical research and radiopharmaceuticals are manufactured. Emission, environmental and meteorological measurements were used in the EPA COMPLY code and in environmental assessment models developed specifically for these sites to compare their ability to predict off-site measurements. The models and code were then used to determine potential dose to hypothetical maximally exposed receptors and the ability of these methods to demonstrate whether these facilities comply with proposed radionuclide emission standards assessed. In no case did the models and code seriously underestimate off-site impacts. However, for certain radionuclides and chemical forms, the EPA COMPLY code was found to overestimate off-site impacts by such a large factor as to render its value questionable for determining regulatory compliance. Recommendations are offered for changing the code to enable it to be more serviceable to radionuclide users and regulators.

**34993** (CONF-910137–, pp. 109) **Air sampling in the workplace to meet the new part 20 requirements.** McGuire, S. (Nuclear Regulatory Commission, Washington, DC (USA)); Hickey, E.E.; Knox, W. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. DOE Contract AC06-76RL01830. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The US Nuclear Regulatory Commission is developing a Regulatory Guide on air sampling in the workplace to meet the requirements of the revised Part 20. The guide will be accompanied by a technical manual describing and giving examples of how to meet the recommendations in the guide. Draft versions of the guide and manual are scheduled to be published for public comment this year. A final guide and manual, revised to consider the public comments, are scheduled to be published in 1992. This talk will summarize some of the more important features of the guide and manual. In particular, the talk will discuss how to demonstrate that samples taken to estimate worker intakes are representative of the air inhaled by workers and what measurements are necessary if a licensee wants to adjust derived air concentrations to account for particle size.

**34994** (CONF-9107104–15) **Can sulfate fluxes in forest canopy throughfall be used to estimate atmospheric sulfur deposition?: A summary of recent results.** Lindberg, S.E. (Oak Ridge National Lab., TN (United States)); Garten, C.T. Jr.; Cape, J.N.; Ivens, W. Oak Ridge National Lab., TN (United States). [1991]. 11p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC05-84OR21400. From 5. international conference on precipitation scavenging and atmosphere surface exchange process; Richland, WA (United States); 15-19 Jul 1991. Order Number DE92000044. Source: OSTI; NTIS; GPO Dep.

The flux of sulfate is forest throughfall and stemflow (the sum of which is designated here as TF) may be an indicator of the atmospheric deposition of S, particularly if foliar leaching of internal plant S is small relative to washoff of deposition. Extensive data from 13 forests indicate that annual sulfate fluxes in TF and in atmospheric deposition are very similar, and recent studies with $^{35}S$ tracers indicate that leaching is only a few percent of total TF. However, some short-term deposition/TF comparisons show large differences, and there remain questions about interpretation of tracer results. Considering the data, we conclude that TF may be used under some conditions to estimate deposition within acceptable uncertainty limits, but that some assumptions need further testing. If TF does reflect deposition, these data suggest that commonly used methods and models seriously underestimate total S deposition at some sites. 39 refs. ,4 figs., 1 tab.

**34995** (DISP-ARA-RAM–90-01) **Natural radioactivity in Italy: 1988 annual report (vol. 1 national networks).** Ingarrica, A.; Mancioppi, S. ENEA, Rome (Italy). Direzione Sicurezza Nucleare e Protezione Sanitaria. 1990. 134p. (In Italian). Order Number DE92705883. Source: OSTI; NTIS (US Sales Only).

This paper provides a panorama of natural radioactivity present in Italy with the aim of increasing the knowledge base on the relative effects on the environment due to human activities, and of evaluating the overall effects due to the presence of radionuclide concentrations in the environment on public health. The overview is based on data collected during a radioecological survey conducted in 1988 by the national monitoring network of ENEA (the Italian Commission for Nuclear and Alternative Energy Sources). The results are expressed in SI (International System) units. An analysis of the results makes it possible to determine that there was no appreciable change in radioecological concentrations of cesium 137 with respect to those reported immediately after the Chernobyl accident. Average annual values of radionuclides present in the food chain are lower than those for the preceding year.

**34996** (DOE/ER/60227–6) **Maintenance of a rural precipitation chemistry center at Whiteface Mountain: Final report.** Mohnen, V.A. State Univ. of New York, Albany, NY (United States). Research Foundation. 1 Sep 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-84ER60227. Order Number DE92000033. Source: OSTI; NTIS; GPO Dep.

For the Past 11 years, Whiteface Mountain (WFM) has been successfully collecting data according to the MAP3S (Multistate Power Production Pollution Study) protocols. These protocols include field sampling, laboratory procedures, sample handling and shipment, and supporting measurements at the summit or lodge including meteorological and air quality parameters. All blind tests and audits have been successfully passed. Since the beginning of the MAP3S program it was recognized that, because of its remoteness, WFM needed some additional support to process the samples and to obtain site specific supporting data. The primary purpose of this funding was to insure the technical support to maintain the availability of WFM so that the necessary high quality research monitoring could continue. In addition, during the past year, we were able to: (1) perform all operations required by the National Trends Network (NTN) precipitation monitoring network: (2) begin the comparison of MAP3S data with similar data taken at WFM; (3) begin a series of ion chromatography measurements on MAP3S duplicate samples (when sufficient volume was available) to study the effect of time delays between sample collection and chemical analysis: (4) provide wet deposition data to the EPA Mountain Cloud Chemistry Program (MCCP); (5) assess the precipitation data quality of the ENSR measurements collocated with MAP3S. Selected results are presents. 6 refs., 1 fig.

**34997** (DOE/RL–01830T-H6) **Processes for identifying regional influences of and responses to increasing atmospheric $CO_2$ and climate change — the MINK Project: Report 1, Background and baselines.** Resources for the Future, Inc., Washington, DC (United States). Aug 1991. 113p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7540). Order Number DE91018601. Source: OSTI; NTIS; GPO Dep.

This is the first of a series of reports of research contributing to the study Processes for Identifying Regional Influences of and Responses to Increasing Atmospheric $CO_2$ and Climate Change –MINK Project. This Report is intended to provide background information on project organization and methodology. In Sections 2 and 3 the region chosen for study and the scenario of climate change applied to it are described. The remainder of the paper provides information on the current functioning of the region – its demography and macroeconomic characteristics, its major natural

resource sectors, and way these sectors interlink among themselves and with other industries and the region's economic base. In the final section projections are made of the demographics and macroeconomic characteristics of the region 20 and 40 years into the future. 54 refs., 15 figs., 23 tabs.

**34998** (DOE/RL–01830T-H7) **Processes for identifying regional influences of and responses to increasing atmospheric $CO_2$ and climate change – the MINK Project: Report 2A, Agricultural production and resource use in the MINK Region without and with climate change.** Crosson, P.R. (Resources for the Future, Inc., Washington, DC (United States)); Katz, L.A.; Wingard, J. Resources for the Future, Inc., Washington, DC (United States). Aug 1991. 123p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018602. Source: OSTI; NTIS; GPO Dep.

The second report of a series contributing to the study Processes for Identifying Regional Influences of and Responses to Increasing Atmospheric $CO_2$ and Climate Change – The MINK Project is composed of two parts. This Report (2A) treats agriculture in MINK in terms of state and region-wide production and resource use for the main crops and animals in the baseline periods of 1984/87 and 2030. The effects of the analog climate on the industry at this level of aggregation are considered in both baseline periods. 72 refs., 12 figs., 26 tabs.

**34999** (DOE/RL–01830T-H11) **Processes for identifying regional influences of and responses to increasing atmospheric $CO_2$ and climate change: The MINK project: Report 5, Energy.** Darmstadter, J. Resources for the Future, Inc., Washington, DC (United States). Aug 1991. 60p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018606. Source: OSTI; NTIS; GPO Dep.

This is the fifth of a series of reports of research contributing to the study Processes for Identifying Regional Influences of and Responses to Increasing Atmospheric $CO_2$ and Climate Change – The MINK Project. This report is directed to an analysis of the possible impacts of climatic change on energy in the Missouri-Iowa-Nebraska-Kansas (MINK) region. It follows a uniform methodological strategy that is applied to the four resource sectors most likely to be impacted by climate change, i.e. agriculture, forestry, water resources and energy. The methodological strategy is fully explained in Report 1 of this series. 43 refs., 1 fig. 12 tabs.

**35000** (DOE/RL–01830T-H12) **Processes for identifying regional influences of and responses to increasing atmospheric $CO_2$ and climate change: The MINK project: Report 6, Consequences of climate change for the MINK economy: Impacts and responses.** Bowes, M.D.; Crosson, P.R. Resources for the Future, Inc., Washington, DC (United States). Aug 1991. 58p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7564). Order Number DE91018607. Source: OSTI; NTIS; GPO Dep.

This is the sixth of a series of reports of research contributing to the study Processes for Identifying Regional Influences of and Responses to Increasing Atmospheric $CO_2$ and Climate Change – The MINK Project. This report is directed to providing an integrated analysis of the possible economic impacts of climatic change on resources in the Missouri-Iowa-Nebraska-Kansas (MINK) region. It is based on a uniform methodological strategy that was applied to the four resource sectors most likely to be impacted by climate change, i.e., agriculture, forestry, water resources and energy. The methodological strategy is fully explained in Report 1 of this series. 19 refs., 9 tabs.

**35001** (DOE/RL–01830T-H13) **Processes for identifying regional influences of and responses to increasing atmospheric $CO_2$ and climate change: The MINK project: An overview.** Rosenberg, N.J.; Crosson, P.R. Resources for the Future, Inc., Washington, DC (United States). Aug 1991. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (PNL–7565). Order Number DE91018608. Source: OSTI; NTIS; GPO Dep.

This overview report explains the rationale for and the methodology used in conduct of the study "Processes for Identifying Regional Influences of and Responses to Increasing Atmospheric $CO_2$ and Climate Change – The MINK Project" commissioned by the US Department of Energy. The MINK project includes four states – Missouri, Iowa, Nebraska and Kansas. The major findings of the study are also presented in this overview, which accompanies a series of reports in which the requisite technical details on methodology, sectoral analyses and integrated analysis of climate change impacts and responses are provided in detail. The report topics in this analysis series of potential greenhouse effects are: (1) background and baseline; (2) agricultural production and resource use in the MINK region without and with climate change; (3) a farm-level simulation of the effects of climate change on crop productivity in the MINK region; (4) forest resources; (5) water resources; (6) energy; (7) consequences of climate change for the MINK economy: impacts and responses.

**35002** (DTH-LET-RE–90-9) **Emission models for individual and public transport vehicles.** Sorenson, S.C.; Pedersen, P.H. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. Dec 1990. 36p. (In Danish). Order Number DE92703922. Source: OSTI; NTIS (US Sales Only).

Computerized calculation models for reckoning emission quantities of carbon monoxide, nitrous oxide and particles from petrol-driven cars, (both with and without catalysators), lighter diesel-driven vehicles, town buses and heavy lorries driving in the town centre of Copenhagen are presented. Cars are reckoned as driven at under 90 km per hour and heavier vehicles for less than 50 km per hour. The models accept various driving patterns and reckon emission after amount per length of road. Models are also given in relation to increased emission due to the age of the vehicle and also for emissions in relation to a vehicle's "cold start" in the case of cars. (AB) 25 refs.

**35003** (EGG–1183-1423) **NATS support summary Schooner event, Nevada Test Site.** Weissman, V.F.; Hand, J.E. EG and G, Inc., Las Vegas, NV (United States). 25 Feb 1969. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018194. Source: OSTI; NTIS; GPO Dep.

This report contains the flight log of the Nevada Aerial Tracking System (NATS) aerial monitoring of radioactive effluents and fallout deposits of the Schonner Event at the Nevada Test Site. The NATS/ARMS tracking activities originated in the Central Nevada and Utah area. After effluent traverse across the Rocky Mountains, the track continued across Colorado, Kansas, Oklahoma, Arkansas, Mississippi, Alabama, Georgia and Florida. The leading edge made its exit from the Continental United States at approximately H + 52 hours with the trailing edge exit occurring at approximately H + 56.5 hours. Maps are included in the report which depict where positive could contact was established. The pre-event meteorological mission in support of Project Schooner are detailed in this report. These flight paths provided wind and temperature data upwind and downwind of the ground zero site. Cloud intensities and spectral data are included. (BN)

**35004** (EGG–1183-1731) **Aerial radiological surveys of the areas surrounding the Diablo Canyon, San Onofre, and Trojan Nuclear Power Plants, Diablo Canyon and San Clemente, California, and Prescott, Oregon: Dates of surveys: July 1975 and April 1976.** Boyns, P.K. EG and G, Inc., Las Vegas, NV (United States). Jul 1978. 11p. Sponsored by USDOE, Washington, DC (United States); Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018196. Source: OSTI; NTIS; GPO Dep.

The Aerial Measuring Systems (AMS) King Air A-100 aircraft was used to survey the areas surrounding the Diablo Canyon Nuclear Power Plant, Diablo Canyon, California, on 7 July 1975; the San Onofre Nuclear Generating Station, San Clemente, on 9 April 1976; and the Trojan Nuclear Plant, Prescott, Oregon, 1 July 1975. Due to the rapidly changing topography in the survey areas, a constant altitude above terrain could not be maintained for an accurate conversion of the aerial data to an equivalent terrestrial exposure rate. The major roads, in relatively flat terrain, were flown to collect as much spectral data as possible within a 23 km radius of the reactor facilities. At San Onofre, the coastal area north of Oceanside and south of San Clemente was surveyed wit 0.46 km line spacings. The area was only 5 km wide, but did permit the collection of

some spectral data and conversion of the aerial data to a terrestrial exposure rate. No man-made gamma ray emitting isotopes were detected in the surveys of the three reactor areas. A complete description of the AMS system, survey procedures, data reduction techniques, and sensitivity has been published. The rugged terrain in the survey areas will decrease the sensitivity of the AMS system to detect isolated sources since they could be partially shielded by the rough terrain. However, the minimum detectable levels of man-made sources would be within a factor of 2–3 of the published sensitivities. The maximum exposure rate in the three surveys was less than 10 $\mu$R/h, using the exposure factor for flat terrain. 1 ref., 7 figs.

**35005** (ETDE-IT–91-54) **Study of acid depositions and their effects on soil of Casaccia (Rome).** Doytchinov, S. ENEA, Casaccia (Italy). Area Energia, Ambiente e Salute. 1990. 24p. (CONF-900921–2: International conference on acid deposition: its nature and impacts, Glasgow (United Kingdom), 16-21 Sep 1990). Order Number DE92705886. Source: OSTI; NTIS (US Sales Only).

From International conference of acid deposition; Glasgow, Great Britain (16-21 Sep 1990).

In Italy the boundary air pollutants are around 30% coming generally from Central Europe. By studying the environmental effects of air pollutants in northern Italy, it was determined that about 30% of the vegetation in this part of the country is damaged. During 1987-1988, the composition of the wet depositions and the temporal variations of the soil pH in one rural area, Casaccia, situated 35 km north of Rome, were studied. In parallel, a similar study was carried out in the National Park of Abruzzo, situated 200 km east from Rome, 1000 m above sea level. It was chosen as a reference point to study the distant air pollutants and to validate the Casaccia sampling data. Results of the study are: the physical-chemical composition of the wet depositions is quite variable because of the different phenomena by which they were formed; the meteoclimatic situation of the region is characterized by air flows prevailing from N/NW (35%), SW/WSW (33%); during the study period in Casaccia, sulphates and chlorides dominated the physical-chemical composition of the wet depositions (very often the sulphates were of antropic and chloride natural origin); because of the high cation exchange capacity of the soil, its pH in the sampling points was very stable and not affected by rainfall.

**35006** (ETDE-mf–2704465) **Investigations of the wet and dry deposition of air pollutants into forest stands of the Black Forest and Schoenbuch. Final report.** Universitaet Stuttgart, Institut fuer Verfahrenstechnik und Dampfkesselwesen - Abteilung Reinhaltung der Luft. Bericht. Baumbach, G.; Droescher, F.; Mikisch, E. Stuttgart Univ. (Germany). Inst. fuer Verfahrenstechnik und Dampfkesselwesen; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Jan 1991 139p. (In German). Contract BMFT 0339223B. Order Number DE92704465. Source: OSTI; NTIS (US Sales Only).

Two spruce stands, the one in the northern Black Forest strongly affected by the recent forest decline, the other in the Schoenbuch near the metropolitan area of Stuttgart only little affected, are compared with respect to the exposition to atmospheric pollutants. The Black Forest site is much less exposed to pollutants in precipitation and in atmospheric particles than the Schoenbuch location, though the relative composition is similar at both sites. Peak concentrations during special long range transport episodes amount at both sites to equally high values. The wet deposition is also comparable due to greater precipitation heights in the Black Forest. With the help of a semi-empirical deposition model for particles in the forest canopy which was developed within this study the particle deposition was quantified for a half year period. This allows to estimate the contribution of the different forms of deposition (for sulfate: precipitation 1/2, particles 1/4, gas 1/4). Deposited particle mass stems predominantly from the coarse particle mode. The deposition of small particles requires their scavenging in fog or cloud droplets of their coalescence. There is a strong increase in particle deposition with increasing height in the canopy (exposed trees experience deposition rates several times the average value). Particle deposits frequently exhibit a buffering capacity which is reflected in low acid concentrations in dew water, especially in the Schoenbuch. Extreme pollutant concentrations in the adherent water on needles may be associated with fog, dew, and the melting water of snow and frost. (orig.) With 81 refs., 18 tabs., 50 figs.

**35007** (ETDE-mf–2714297) **Nuisances from gaseous air pollutants at the Bergstrasse. Measuring report.** Umweltplanung, Arbeits- und Umweltschutz. Bender, M.; Liebl, K.; Paul, R.; Regeler, W. Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany). Mar 1990 43p. (In German). Order Number DE92714297. Source: OSTI; NTIS (US Sales Only).

In order to establish the area distribution of nuisances from air pollutants, a multi-component nuisance measuring vehicle of the environment agency of the Land Hessen was used in the measuring district Bergstrasse during the period from Juli 1986 to June 1987. The following individual air pollutants were measured using continuously recording nuisance measuring devices: sulfur dioxide, carbon monoxide, nitrogen monoxide, nitrogen dioxide, total amount of gaseous, organic compounds (without methane portion), and ozone. Within the framework of this measuring programme, 13 individual measurements were carried out at each measuring point for the duration of 30 minutes each between 8 a.m. and 6 p.m. A time-table was drawn up where the individual measurements at a single point were distributed as evenly as possible over the entire period. This was done to compensate possible influences of variations of daily or yearly pollutant concentration curves for calculating the characteristic figures. (orig./KW).

**35008** (ETDE-mf–2714313) **Development of simple, powerful and economic measuring methods for control of hazardous materials at work places using thermal analysis.** Hartkamp, H.; Rottmann, J. Wuppertal Univ. (Gesamthochschule) (Germany). Fachbereich 9 - Naturwissenschaften 2 - Chemie - Biologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). 1991 43p. (In German). Contract BMFT 01HK854. Order Number DE92714313. Source: OSTI; NTIS (US Sales Only).

The importance of trace gas analysis is presently increasing more and more especially in controlling the concentrations of hazardous materials in work place atmospheres, in ambient and indoor air and also in exhalations of polluted soils, waters or waste deposits. This requires fast, simple and low-cost methods. They have to be practicable by persons without a special qualification. Such methods are not available so far. Within this project, tests have been performed as to the applicability of thermoanalytical methods, especially thermogravimetry and differential scanning calorimetry, to compounds which are generated by gas solid reaction of the trace gas compounds to be analyzed and suitable solid reagents. Such compounds can be addition or condensation products, clathrates or coordination complexes. Suitable sampling systems have been developed using static and dynamic procedures. Promising reaction sytsems have been examined on their reactivity with test gas mixtures. The reaction products have been analyzed with thermoanalytical methods. Gas solid reactions of numerous amines, alcohols, aldehydes, ketones, hydrocarbons and halogenated hydrocarbons have been investigated with 2,4-dinitrophenylhydrazine, urea, thiourea, metal quinaldinates and oxinates. Trace gas compounds are identifiable and quantifiable by the evaluation of the resulting thermoanalytical signals. So, the proposed reactions provide a basis for further development of fast, simple and reliable trace gas analysis using thermoanalytical methods. (orig.) With 15 refs., 28 tabs., 6 figs.

**35009** (EUR–12990) **Real time radioactivity monitoring and its interface with predictive atmospheric transport modelling.** Raes, F. (Commission of the European Communities, Ispra (IT). Joint Research Centre). Commission of the European Communities, Luxembourg (Luxembourg). 1990. 195p. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). Source: OSTI; NTIS (US Sales Only).

After the Chernobyl accident, a programme was initiated at the Joint Research Centre of the Commission of the European Communities named 'Radioactivity Environmental Monitoring' (REM). The main aspects considered in REM are: data handling, atmospheric modelling and data quality control related to radioactivity in the environment. The first REM workshop was held in December 1987: 'Aerosol Measurements and Nuclear Accidents: A Reconsideration'. (CEC EUR 11755 EN). These are the proceedings of the

second REM workshop, held in December 1989, dealing with real-time radioactivity monitoring and its interface with predictive atmospheric models. Atmospheric transport models, in applications extending over time scales of the order of a day or more become progressively less reliable to the extent that an interface with real-time radiological field data becomes highly desirable. Through international arrangements for early exchange of information in the event of a nuclear accident (European Community, IAEA) such data might become available on a quasi real-time basis. The question is how best to use such information to improve our predictive capabilities. During the workshop the present status of on-line monitoring networks for airborne radioactivity in the EC Member States has been reviewed. Possibilities were discussed to use data from such networks as soon as they become available, in order to update predictions made with long range transport models. This publication gives the full text of 13 presentations and a report of the Round Table Discussion held afterwards.

**35010** (EUR–12990, pp. 1-18) **Environmental radioactivity measurements in the field network of the deutscher wetterdienst. Methods and data transfer.** Steinkopff, T. (Deutscher Wetterdienst-Zeutralamt, Offenbach am Main (DE)); Kiesewetter, W.; Jacobsen, I. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling*. 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

On the basis of the Strahlenschutzvorsorgegesetz (StrVG) [(Precautionary Radiological Protection Act)] the Deutscher Wetterdienst (DWD) [(German Meteorological Service)] is responsible for the measurement of radioactivity in the air and precipitation as well as for the preparation of dispersion prognoses. Accordingly a monitoring network of 26 stations will be installed located at meteorological observation stations. At present 20 stations are ready for service. As a part of the measuring program at each station a step-feed filter system ensures real time measurements of radionuclides on aerosols by gamma-ray spectrometry simultaneous to sampling. The measuring-data are transmitted to the Central Office at Offenbach by means of the communication network of the Deutscher Wetterdienst. After verification selected data are used as an input for atmospheric transport models. Measuring data and results of diagnoses and prognoses are transferred to the computer network of the Integriertes MeSS-und Informationssystem zur Uberwachung der Umweltradioaktivitat (IMIS) [(Integrated Measurement and Information System for the Surveillance of Environmental Radioactivity)].

**35011** (EUR–12990, pp. 85-100) **The interpretation of gamma dose rate measurements in terms of airborne and deposited activity.** Weiss, W. (Bundesamt fuer Strahlenschutz, Freiburg (DE). Inst. fuer Atmosphaerische Radioaktivitaet); Stoehlker, U.; Bieringer, P.; Zaehringer, M.; Sartorius, H. Commission of the European Communities, Luxembourg (Luxembourg). 1990. (CONF-8912155–: 2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling, Ispra (Italy), 5-6 Dec 1989). In *Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling*. 195p. Order Number DE92703670. Source: OSTI; NTIS (US Sales Only).

In cases, in which the gamma dose rate in the environment reaches levels which are relevant for the external exposure of the population, the qualification and the interpretation of such measurements is straight forward. In cases, however, in which on-line gamma dose rate measurements are used for early warning purposes and as input data for radioecological models, the detectable increase of the dose rate relative to its natural value should be as low as possible. If used as input data for radiological models the contributions of airborne and deposited activity to the dose rate must be known. In a contamination situation the interpretation of dose rate measurements requires informations such as: - the absolute value and the geographical and temporal variability of the natural dose rate, - the absolute value and the isotopic composition of the contamination of the air and of the ground, - the type and the intensity of deposition processes. The qualification and interpretation of dose rate measurements in terms of these parameters is discussed both on a theoretical basis and on the basis of experimental data. Most of the experimental data are taken from the German dose rate monitoring network, WADIS, which is operated by the Office of Civil Defense (BZS).

**35012** (Juel–2488) **Sources and distribution of $NO_x$ in the upper troposphere at northern midlatitudes.** Ehhalt, D.H.; Rohrer, F.; Wahner, A. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Chemie 3 - Atmosphaerische Chemie. Jun 1991. 41p. Order Number DE92714345. Source: OSTI; NTIS (US Sales Only).

A simple quasi 2-D model is used to study the zonal distribution of $NO_x$. The model inlcudes vertical transport in form of eddy diffusion and deep convection, zonal transport by a vertically uniform wind, and a simplyfied chemistry of NO, $NO_2$ and $HNO_3$. The $NO_x$ sources considered are surface emissions (mostly from the combustion of fossil fuel), lightning, aircraft emissions, and downward transport from the stratosphere. The model is applied to the latitude band of 40deg N to 50deg N during the month of June; the contributions to the zonal $NO_x$ distribution from the individual sources and transport processes are investigated. The model predicted $NO_x$ concentration in the upper troposphere is dominated by air lofted from the polluted planetary boundary layer over the large industrial areas of Eastern North America and Europe. Aircraft emissions are also important and contribute on average 30%. Stratospheric input is minor about 10%, less even than that by lightning. The model provides a clear indication of intercontinental transport of $NO_x$ and $HNO_3$ in the upper troposphere. Comparison of the modelled NO profiles over the Western Atlantic with those measured during STRATOZ III in 1984 shows good agreement at all altitudes. (orig.).

**35013** (LA-UR–91-2957) **Issues in continuous air monitoring.** Rodgers, J.C. Los Alamos National Lab., NM (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9108162–2: Department of Energy (DOE) radiation protection conference, Knoxville, TN (United States), 27-29 Aug 1991). Order Number DE92000248. Source: OSTI; NTIS; INIS; GPO Dep.

The Health Physics groups at Los Alamos determined that the 15 yr-old alpha CAM instrumentation in use at the Laboratory would soon have to be replaced and upgraded. A program was initiated to prepare detailed performance specifications, evaluate new CAM instrumentation being offered, and if necessary, to develop advanced technologies which would enable the Laboratory to meet or exceed all of the requirements of the new DOE Order 5480.11. "Radiation Protection for Occupational Workers" (DOE, 1988), and other related Orders and standards. After careful evaluation of available alpha CAMs and consideration of the many factors affecting CAM performance, a project for the design, and development of advance CAM technology was initiated. This project culminated in the completion of a new alpha CAM concept featuring advances in the design of the CAM inlet enabling discrimination against radon daughters, in the multi-channel analyzer electronics, in the data processing and communication electronics, and in background compensation algorithm. The objective in the following discussion is examine the DOE Order 5480.11 requirements in some detail. While the new CAM sensitivity requirement is of critical importance, this is only one of many requirements of the Order with implications for CAM design, placement and operation. It is essential to orient our thinking about CAMs to the primary objectives of the Order with air monitoring implications. This paper discusses air monitoring issues in the Order. 7 refs.

**35014** (LBL–27170-1991) **Annual site environmental report of the Lawrence Berkeley Laboratory: Data for calendar year 1990.** Schleimer, G.E.; Pauer, R.O. (eds.). Lawrence Berkeley Lab., CA (United States). May 1991. 105p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000646. Source: OSTI; NTIS; INIS; GPO Dep.

The Environmental Monitoring Program of the Lawrence Berkeley Laboratory is described. Data for 1990 are presented, and general trends are discussed. The report is organized under the following topics: Environmental Program Overview; Environmental

Permits; Environmental Assessments; Environmental Activities; Penetrating Radiation; Airborne Radionuclides; Waterborne Radionuclides; Public Doses Resulting from LBL Operations; Trends – LBL Environmental Impact; Waterborne Pollutants; Airborne Pollutants; Groundwater Protection; and Quality Assurance. 20 refs., 26 figs., 23 tabs.

**35015** (LBL–31118) **Soot in the stratosphere: The impact of current and HSCT aircraft emissions.** Hansen, A.D.A. (Lawrence Berkeley Lab., CA (United States)); Pueschel, R.F.; Snetsinger, K.G. Lawrence Berkeley Lab., CA (United States). Aug 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Contract A97524C. (CONF-9109290–1: Aircraft design meeting, Baltimore, MD (United States), 23-25 Sep 1991). Order Number DE92000686. Source: OSTI; NTIS; GPO Dep.

One of the trace components of emissions from aircraft engines and other combustion sources are soot particles. These particles are strongly absorbing in the visible and IR spectra, may act as condensation nuclei, and may provide a large surface area for the catalytic promotion of gas-phase chemical reactions. Soot if found throughout the troposphere, even at remote locations, and also in the stratosphere. Present techniques do not allow an unambiguous identification of the sources. This paper discusses the emission of soot from existing and proposed aircraft and the contribution of this soot to concentrations observed in the troposphere and stratosphere. We consider the implications of these emissions for issues in stratospheric physics and chemistry. 11 refs.

**35016** (NEI-DK–638) **Formation of hygrogen chloride during waste incineration.** Dalager, S.; Hansen, L. DK-Teknik, Soeborg (Denmark). Oct 1990 90p. (In Danish). Order Number DE92703888. Source: OSTI; NTIS (US Sales Only).

1.75 million tons of mainly municipal, but also industrial, wastes are incinerated in Denmark each year. Danish authorities are concerned about the emission of hydrogen chlorides caused by the combustion of PVC. A description of the character of the flue gas, fly ash and slag produced by waste incineration is given in addition to a brief explanation of various methods used for flue gas cleaning. The kinetics of PVC combustion are also presented. (AB) 10 refs.

**35017** (ORNL/TM–11895) **A standard test set for numerical approximations to the shallow water equations in spherical geometry.** Williamson, D.L. (National Center for Atmospheric Research, Boulder, CO (United States)); Hack, J.J.; Jakob, R.; Swarztrauber, P.N.; Drake, J.B. Oak Ridge National Lab., TN (United States). Aug 1991. 29p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000385. Source: OSTI; NTIS; GPO Dep.

A suite of seven test cases is proposed for the evaluation of numerical methods intended for the solution of the shallow water equations in spherical geometry. The shallow water equations exhibit the major difficulties associated with the horizontal dynamical aspects of atmospheric modeling on the spherical earth. These cases are designed for use in the evaluation of numerical methods proposed for climate modeling and to identify the potential tradeoffs which must always be made in numerical modeling. Before a proposed scheme is applied to a full baroclinic atmospheric model it must perform well on these problems in comparison with other currently accepted numerical methods. The cases are presented in order of complexity. They consist of advection across the poles, steady state geostrophically balanced flow of both global and local scales, forced nonlinear advection of an isolated low, zonal flow impinging on an isolated mountain, Rossby-Haurwitz waves and observed atmospheric states. One of the cases is also identified as a computer performance/algorithm efficiency benchmark for assessing the performance of algorithms adapted to massively parallel computers. 31 refs.

**35018** (RFP–4451) **Development of a non-radiological air emissions inventory for a nuclear industrial facility.** Patnoe, C.A.; Porter, G.V.; Almquist, R.S. EG and G Rocky Flats, Inc., Golden, CO (United States). [1991]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. (CONF-9109253–1: Joint EPA and Air and Waste Management Association (AWMA), air inventory issues of the 1990's, Durham, NC (United States), 11 Sep 1991). Order Number DE91018395. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the major issues that impacted the organization and structure of a project for developing a comprehensive non- radiological air emissions inventory for a nuclear weapons facility. The major issues addressed paralleled the development of the inventory project and fall into the following categories: (1) defining the scope of work, (2) developing and managing the air emission inventory project, and (3) field investigations and evaluating operations for air emissions. This paper also describes the lines of communication that were established with state regulators to resolve problems and develop a successful working relationship. This paper illustrates a means to complete a complex air emission inventory with proper organization and cooperation with regulatory agencies. Further, it indicates the need of critical evaluation of project tasks to evaluate their impact on project schedule; it provides a method for implementing a quality assurance program that audits all phases of the emission survey; and it demonstrates a way of effectively managing outside contractors to meet schedule requirements and assure a high quality product. This paper is of value to those undertaking a similar complex air emission survey. 2 refs.

**35019** (UCRL-ID–108377) **A condensed global photochemical mechanism for two-dimensional atmospheric models.** Tamaresis, J.; Kinnison, D.E.; Wuebbles, D.J. Lawrence Livermore National Lab., CA (United States). [1991]. 24p. Sponsored by Environmental Protection Agency, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000101. Source: OSTI; NTIS; GPO Dep.

A condensed chemical mechanism that represents the reactions of organic compounds in the atmosphere is developed and tested using a one-dimensional model. Due to the differences between the full and condensed mechanisms, the reduced version cannot be considered an accurate predictor of globally important trace species concentrations. The condensed mechanism must be improved before it can be used with confidence in two-dimensional models. Appendix contains both full and reduced mechanisms of photolysis and thermal reactions as well as species profile comparisons. 3 refs., 8 figs.

**35020** (UCRL-JC–106334) **Statistical character of toxic metal concentrations in soil samples contaminated by atmospheric deposition: Implications for compliance.** Shinn, J.H.; Gouveia, F.J. Lawrence Livermore National Lab., CA (United States). May 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-910659–33: 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA), Vancouver (Canada), 16-21 Jun 1991). Order Number DE91018467. Source: OSTI; NTIS; GPO Dep.

The requirements of recent regulations for airborne toxic substances are sometimes interpreted to mean an assessment of the fate and environmental effects of metal particles deposited on the landscape by atmospheric processes. This paper examines the problems of sampling soil for deposited metals. The statistical character of contaminants in soil is not well understood by the administrators of environmental compliance, nor by persons responsible for soil sampling. Fortunately, there have been sufficient studies of metal concentrations in soil contaminated by atmospheric deposition that some generalizations can be drawn. Here we show some practical results that will aid in answering many questions about soil sampling such as: How many samples are required to estimate the central tendency (mean or median)? How large should an analyzed aliquot be to assure reproducible results? How many samples in a population will be out of compliance when the mean or median is well within compliance? When remedial action is taken, how clean is clean? 6 refs., 2 figs.

**35021** (VTT-TIED–1199) **$SO_2$ and $NO_x$ emission scenarios and the costs of reduction measures in Finland.** Taehtinen, M. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Ydinvoimatekniikan Lab.). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1991. 55p. (In Finnish). Order Number DE92704005. Source: OSTI; NTIS (US Sales Only).

Sulphur emissions are calculated on the basis of fuel consumption, sulphur content of fuels, assumptions on the development of production in process industry. Emission reduction measures are taken into account. In calculation of $NO_x$ emissions prognosis of car fleet and traffic performance are also needed. Sulphur emissions have been calculated for two main control strategies: reduction measures mandated by the Finnish government, and strict reduction measures to test the effect of best available emission abatement measures. Nitrogen oxides emissions are calculated with emission reduction measures proposed by the Nitrogen Oxides Commission. Potential of energy conservation and use of nature gas is considered and control costs caused by different strategies are estimated. The emission restrictions confirmed by the state will decrease the sulphur dioxid emissions to a level of 200000 tons per year. Estimated control costs are in the year 2000 about 700 million FIM (per year). If energy is used in a more effective war use of natural gas is increased and the reduction measures are stricter, it is possible to reach a yearly sulphur dioxide emission level of 100000 tons after the year 2000. Estimated control costs for stricter reduction measures are about 1000 million FIM per year. Reduction of nitrogen oxides emissions is more difficult and more expensive than reduction of sulphur emissions. Catalytic converters in passenger cars will stop the growth of the total $NO_x$ emissions in Finland. To decrease the total $NO_x$ emission restrictions are also needed for energy production and industrial plants as well as for other car types.

35022 (WHC-EP–0145-3) **Westinghouse Hanford Company Environmental surveillance annual report–200/600 Areas: Calendar year 1990.** Schmidt, J.W.; Huckfeldt, C.R.; Johnson, A.R.; McKinney, S.M. Westinghouse Hanford Co., Richland, WA (United States). Jun 1991. 116p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE91018137. Source: OSTI; NTIS; INIS; GPO Dep.

This document presents the results of near-field environmental surveillance in 1990 of the Operations Area of the Hanford Site, in south central Washington State, as performed by Westinghouse Hanford Company. These activities are conducted in the 200 and 600 Areas to assess and control the impacts of operations on the workers and the local environment. Surveillance activities include sampling and analyses of ambient air, surface water, groundwater, sediments, soil, and biota. Also, external radiation measurements and radiological surveys are taken of waste disposal sites, radiological control areas, and roads. 16 refs., 3 figs., 1 tab.

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*Refer also to citation(s) 33717, 33736, 33747, 33783, 33788, 33789, 33797, 33798, 33802, 33805, 33876, 33891, 34163, 34179, 34186, 34190, 34230, 34231, 34232, 34233, 34408, 34805, 34846, 34961, 34994, 34999, 35000, 35001, 35003, 35005, 35011, 35020, 35022, 35079, 35080, 35146, 35150, 35533*

35023 (ANL/CP–72961) **Effect of radon dose on cleanup criteria and using RESRAD for chemical risk assessment.** Yu, C. (Argonne National Lab., IL (United States)); Cheng, J.-J.; Wallo, A. III. Argonne National Lab., IL (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910931–20: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE92000356. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy has used RESRAD, a pathway analysis program developed at Argonne National Laboratory, in conjunction with the as low as reasonably achievable (ALARA) principle to develop site-specific residual radioactive material guidelines (cleanup criteria) for many sites. This study examines the effects of the radon pathway, recently added to the RESRAD program, on the calculation of uranium, radium, and thorium cleanup criteria. The results show that the derived uranium guidelines will not be affected by the radon ingrowth considerations. The effect of radon on radium and thorium generic guidelines is more significant, but the model does indicate that at the generic soil limits used for radium and thorium the indoor radon decay product concentrations would be below the 0.02 working level standard. This study also examines the feasibility of applying RESRAD to chemical risk assessment. The results show that RESRAD can perform risk assessment of toxic chemicals after simple modifications. Expansion of the RESRAD database to include chemical compounds will increase its capability to handle chemical risk assessments. 11 refs., 3 tabs.

35024 (ANL/CP–73676) **Geophysical identification of leachate levels and refuse characterization in a landfill at Argonne National Laboratory, Illinois.** Carpenter, P.J. (Northern Illinois Univ., De Kalb, IL (United States). Dept. of Geology); Xi, Y.; El-Hussain, I.W.; Moos, L. Argonne National Lab., IL (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9109134–1: 34. annual meeting of the Association of Engineering Geologists: environmental and geotechnical challenges for the decade, Chicago, IL (United States), 30 Sep - 4 oct 1991). Order Number DE92000264. Source: OSTI; NTIS; GPO Dep.

Magnetic and electrical geophysical techniques were used to survey the 800 Area landfill at Argonne National Laboratory as part of an environmental site assessment. This landfill was opened in 1966 and has accepted non-radioactive laboratory, office, food service and construction wastes. Magnetic profiles and electrical resistivity surveys using Wenner, Schlumberger and dipole-dipole arrays were made primarily over the northern portion of the landfill and long its margins. Mounding of leachate to within 5 ft. (1.5 m) of the surface was identified within the north-central and northeastern portions of the landfill using resistivity soundings and dipole-dipole surveys. Soundings also suggest refuse thickness varies from 10–30 ft (3–10 m) south to north across the landfill. Both dipole-dipole and magnetic profiles have identified conductive and insulating objects in the refuse. Areas of low resistivity flanking the northeastern and eastern margins of the landfill may represent migration of leachate to the north and east. High resistivity layers detected beneath the landfill suggest little or no downward percolation of mineralized leachate. Such high resistivity layers, however, may indicate the presence of sand and gravel layers/lenses embedded in the drift which are potential contaminant pathways. The geophysical results are presently being used in optimum placement of monitoring wells, soil gas probes and future remediation planning. 5 refs., 6 figs.

35025 (CONF-9108159–1) **Radon transport and entry in hilly karst terrains.** Gammage, R.B.; Dudney, C.S.; Wilson, D.L. Oak Ridge National Lab., TN (United States). Aug 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Department of Energy-Office of Health and Environmental Research (DOE-OHER) radon contractors' meeting; Albuquerque, NM (United States); 23-25 Aug 1991. Order Number DE91018938. Source: OSTI; NTIS; INIS; GPO Dep.

This report consists of copies of the view graphs used for the talk "Radon Transport and Entry in Hilly Karst Terrains," presented at the DOE-OHER Radon Contractors' Meeting held in Albuquerque in August, 1991. The report describes how aerostatic effects can alter indoor radon concentrations, using houses in Oak Ridge and Huntsville as examples. Due to differing terrain topologies, houses in Huntsville have peak radon concentrations in the summer, roughly twice as high as winter values; Oak Ridge houses have peak radon concentrations in the winter, up to 50 times higher than summer values. A critical parameter for subsurface aerostatic transport of radon is the temperature differential between outside air and air in the underground solution cavities. The transport mechanism identified here should operate in other hilly region with karst or fractured/porous bedrock; some of the 100,000 "hottest" houses in the US are in karst regions. 3 figs., 1 tab. (MHB)

35026 (CONF-910920–2) **Seasonal trends in environmental tritium concentrations in a small forest adjacent to a radioactive waste storage area.** Amano, Hikaru (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)); Garten, C.T. Jr. Oak Ridge National Lab., TN (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 4. topical meeting on tritium technology in fission, fusion, and isotopic applications; Albuquerque, NM (United States); 30 Sep - 4 oct 1991. Order Number DE91018937. Source: OSTI; NTIS; GPO Dep.

Tritium (HTO) concentrations were studied for an entire year in a floodplain forest adjacent to a low-level radioactive solid waste storage area (SWSA No. 5) at Oak Ridge National Laboratory (ORNL) near Oak Ridge, Tennessee, USA. Tritium in soil was the principal source of HTO to the deciduous forest. Evaporation from the surface soil along with transpiration from trees leaves both contributed to HTO in the forest atmosphere. During the growing season, transpiration was the principal contributor of HTO to the forest atmosphere, while during the dormant season, the main source of atmospheric HTO was evaporation from the surface soil. Seasonal changes and the characteristics of vegetation will influence the relative importance of evaporation and transpiration as sources of atmospheric HTO near the ground in temperate deciduous forests. 8 refs., 9 figs.

**35027** (CONF-9109234–6) **Patterns of sediment accumulation in Watts Bar Reservoir based on $^{137}$Cesium.** Brandt, C.C.; Rose, K.A.; Cook, R.B.; Dearstone, K.C.; Brenkert, A.L.; Olsen, C.R. Oak Ridge National Lab., TN (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 4. Tennessee water resources symposium; Knoxville, TN (United States); 24-26 Sep 1991. Order Number DE92000067. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy has recently undertaken an environmental restoration program designed to achieve remediation of hazardous materials released from the Oak Ridge Reservation (ORR). The distribution of $^{137}$Cs was investigated in sediments from Watts Barr Reservoir and the Clinch River as a possible marker for other contaminants released from the ORR. We have performed additional analyses on the data gathered for this study to investigate possible relationships between $^{137}$Cs accumulation and reservoir characteristics. We found that $^{137}$Cs deposition correlates with sedimentation rate, and soft mud layers of cores have higher $^{137}$Cs levels than sandy mud or eroded soils. No correlation was found with water depth, distance from shore or distance from release source, but it is important to note the data were not collected to test for these effects. We estimate Watts Barr Reservoir contains 267 Ci of $^{137}$Cs, with 7% of this total in the top 16 cm of sediment, and potentially available for biological accumulation. 2 refs. (MHB)

**35028** (CONF-911254–2) **Humic substance formation during wastewater infiltration.** Siegrist, R.L. (Oak Ridge National Lab., TN (United States)); Hildmann-Smed, R.; Filip, Z.K.; Jenssen, P.D. Oak Ridge National Lab., TN (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 6. national symposium on onsite waste-water treatment; St. Joseph, MI (United States); 16-17 Dec 1991. Order Number DE92000045. Source: OSTI; NTIS; GPO Dep.

Soil infiltration of wastewater effluents is a widely practiced method of treatment and disposal/reuse throughout the world. Renovation of the wastewater results from a wide variety of complex physicochemical and biological processes. One set of processes is speculated to involve the accumulation of organic matter by filtration and sorption followed by formation of humic substances. This humic substance formation can effect the performance of soil treatment systems by contributing to soil pore clogging and reduction in hydraulic capacity, and by yielding reactive substances and an enhancement of purification processes. While there has been a wealth of research into the nature and genesis of humic substances in terrestrial environments, there has been limited research of humic substance formation during soil infiltration of wastewater. The purpose of the research reported herein was to determine if humic substances can form under conditions typical of those present during wastewater infiltration into natural soil systems. This work was conducted during 1989 to 1990 as a collaborative effort between the Centre for Soil and Environmental Research, located in Aas, Norway and the Institute for Water, Soil and Air Hygiene located in Langen, West Germany. 11 refs., 3 figs., 6 tabs.

**35029** (DOE/EA–0467) **Environmental Assessment for the Sacramento Area Office, Western Area Power Administration: Proposed 1994 Power Marketing Plan.** USDOE Western Area Power Administration, Washington, DC (United States). Jun 1991. 99p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018451. Source: OSTI; NTIS; GPO Dep.

The Western Area Power Administration (Western) a Federal Power Marketing Administration within the US Department of Energy, is developing a power marketing plan for Central Valley Project (CVP) power resources that are marketed by Western's Sacramento Area Office (SAO). The plan will govern the sale of power currently sold under electric service contracts which will expire on June 30, 1994. Contracts with other customers, which expire in 2004, will not be covered by the 1994 Power Marketing Plan. As a public agency marketing public power, Western conducts a public process for determining the classes of service it markets and the recipient of the power. Proposals are made and discussed with customers, potential customers, and interested parties, in public information forums, and formal comments are made by the public on the draft plan in a public comment forum. Based on Western's analysis and comments received from interested parties during the scoping process held pursuant to the National Environmental Policy Act (NEPA), four alternative marketing plans have been developed, two of which contain several options. There are three different categories of actions which could be affected by the Proposed Marketing Plan. These are: hydrosystem operations, thermal system operations, and conservation and renewable resources. Changes in these actions could cause environmental impacts. In addition, the chosen Marketing Plan will have some socioeconomic impacts. This Environmental Assessment (EA) addresses the potential environmental impacts of Western's Marketing Plan alternatives. It also includes a discussion of the need for the Marketing Plan and of the public involvement and consultation activities related to the Marketing Plan and the environmental process. Background information on SAO's marketing program is included along with a discussion of the assumptions and methodology and a glossary of power marketing terms and abbreviations used. 5 figs., 37 tabs.

**35030** (DOE/NV/10845–2) **Radionuclides in surface soil at the Nevada Test Site.** McArthur, R.D. Nevada Univ., Las Vegas, NV (United States). Water Resources Center. Aug 1991. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-90NV10845. Order Number DE91018825. Source: OSTI; NTIS; INIS; GPO Dep.

In 1981, the US Department of Energy began the Radionuclide Inventory and Distribution Program, an attempt to assess the amount and distribution of radioactivity in surface soil at the Nevada Test Site (NTS). Over the next several years, researchers used a combination of aerial radiological surveys, soil sampling, and in situ measurements to study the regions of the NTS where soil radioactivity was above background levels. These regions included the ground zeros of above-ground nuclear tests, underground tests that vented, and some safety shots, as well as the sites of nuclear rocket experiments. The results of the program were published in a series of five reports between 1983 and 1989. In this report, those results have been combined to provide an integrated picture of the current levels of soil radioactivity on the NTS. The estimated inventories of the nine most important manmade radionuclides have been reviewed (and in some cases recalculated), decay-corrected to January 1, 1990, and tabulated. New distribution maps have been prepared that show isopleths of decay-corrected radionuclide concentrations over the entire NTS. Two additional maps show the measurement locations where the gamma exposure rate exceeds 100 $\mu$R/hr and where the $^{239,240}$Pu concentration exceeds 500 pCi/g. 21 refs., 12 figs., 6 tabs.

**35031** (DOE/NV/10845–67) **Archaeological studies at Drill Hole U20az Pahute Mesa, Nye county, Nevada.** Simmons, A.H.; Hemphill, M.L.; Henton, G.H.; Lockett, C.L.; Nials, F.L.; Pippin, L.C.; Walsh, L. Nevada Univ., Reno, NV (United States). Desert Research Inst. Jul 1991. 142p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-85NV10384 ;AC08-90NV10845. Order Number DE92000109. Source: OSTI; NTIS; GPO Dep.

During the summer of 1987, the Quaternary Sciences Center (formerly Social Science Center) of the Desert Research Institute (DRI), University of Nevada System, conducted data recovery investigations at five archaeological sites located near Drill Hole U20az on the Nevada Test Site in southern Nevada. These sites were among 12 recorded earlier during an archaeological survey of

the drill hole conducted as part of the environmental compliance activities of the Department of Energy (DOE). The five sites discussed in this report were considered eligible for the National Register of Historic Places and were in danger of being adversely impacted by construction activities or by effects of the proposed underground nuclear test. Avoidance of these sites was not a feasible alternative; thus DRI undertook a data recovery program to mitigate expected adverse impacts. DRI's research plan included controlled surface collections and excavation of the five sites in question, and had the concurrence of the Nevada Division of Historic Preservation and Archaeology and the Advisory Council of Historic Preservation. Of the five sites investigated, the largest and most complex, 26Ny5207, consists of at least three discrete artifact concentrations. Sites 26Ny5211 and 26Ny5215, both yielded considerable assemblages. Site 26Ny5206 is very small and probably is linked to 26Ny5207. Site 26Ny5205 contained a limited artifact assemblage. All of the sites were open-air occurrences, and, with one exception contained no or limited subsurface cultural deposits. Only two radiocarbon dates were obtained, both from 26Ny5207 and both relatively recent. While the investigations reported in the volume mitigate most of the adverse impacts from DOE activities at Drill Hole U20az, significant archaeological sites may still exist in the general vicinity. Should the DOE conduct further activities in the region, additional cultural resource investigations may be required. 132 refs., 71 figs., 44 tabs.

**35032** (DOE/OR–968) **Environmental Restoration and Waste Management Site-Specific Plan for the Oak Ridge Reservation: FY1992.** Department of Energy, Oak Ridge, TN (United States). Oak Ridge Operations Office; Science Applications International Corp., Oak Ridge, TN (United States). Sep 1991. 216p. Sponsored by USDOE, Washington, DC (United States). (ES/ER–20). Order Number DE92000028. Source: OSTI; NTIS; INIS; GPO Dep.

The United States Department of Energy (DOE) is committed to achieving and maintaining environmental regulatory compliance at its waste sites and facilities, while responding to public concerns and emphasizing waste minimization. DOE publishes the Environmental Restoration and Waste Management Five-Year Plan (FYP) annually to document its progress towards these goals. The purpose of this Site-Specific Plan (SSP) is to describe the activities, planned and completed. undertaken to implement these FYP goals at the DOE Field Office-Oak Ridge (DOE/OR) installations and programs; specifically, for the Oak Ridge Reservation (ORR), Oak Ridge Associated Universities (ORAU), and Hazardous Waste Remedial Action Program (HAZWRAP). Activities described in this SSP address hazardous, radioactive, mixed, and sanitary wastes, along with treatment, storage, and disposal of current production waste and legacy waste from past operation. The SSP is presented in sections emphasizing Corrective Activities (A), Environmental Restoration (ER), Waste Management (WM), Technology Development (TD), and Transportation; and includes descriptions of activities, resources, and milestones by installation or program. 87 tabs.

**35033** (EGG–1183-1412) **ARMS (Aerial Radiological Measuring Surveys): Humboldt Bay environmental radiation survey, October–November 1967.** Hand, J.E.; Weissman, V.F. EG and G, Inc., Las Vegas, NV (United States). 13 Nov 1968. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018218. Source: OSTI; NTIS; GPO Dep.

The Aerial Radiological Measuring Surveys (ARMS), operated by EG&G, Inc., Las Vegas, Nevada, for the US Atomic Energy Commission, performed a radiation survey of the Humboldt Bay, California, area between September 28 and October 16, 1967. The survey was made for the Civil Effects Test Operations (CETO) of the Division of Biology and Medicine as part of a continuing nationwide ARMS program started in 1948. One map summarizes the aerial survey activities that have been completed to November, 1967. Other surveys maps and data are included in the survey report. The shoreline of Humboldt Bay, California, is the site of an operational power reactor operated by the Pacific Gas and Electric Company. The reactor is a boiling-water type operating at a normal power level of 52 Megawatts (electrical) which generates continuous gaseous radioactivity waste which is emitted from the exhaust stack. The results of the present survey show that the emitted nuclides are primarily the fission-generated noble gases. Dispersion of these wastes is by atmospheric diffusion over the surrounding countryside, by rainout and similar methods of natural atmospheric scrubbing, and by radioactive decay processes. 9 refs., 16 figs., 5 tabs.

**35034** (EGG–1183-1466) **Aerial Radiological Measuring Surveys (ARMS): Dresden, September 1968.** Anderson, C.N.; Weissman, V.F. EG and G, Inc., Las Vegas, NV (United States). 1 Feb 1970. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018216. Source: OSTI; NTIS; GPO Dep.

The Aerial Radiological Measuring Surveys (ARMS) system , operated for the US Atomic Energy Commission, was used to perform aerial surveys of several operational and non-operational reactor sites during the summer months of 1968. The data collected on this survey provides a catalog file of characteristics of the procedure nuclear installation. The Dresden reactor site is located in northeast Illinois, approximately 10 miles east of the community of Morris. Currently operating at the site is Dresden 1, a boiling water reactor with a capacity of 200 MW(e), owned and operated by the Commonwealth Edison Company. In addition, construction has begun at the same site for Dresden 2 and 3, each to have an 800 MW(e) capability. Information included consists of (1) aerial photographs of the installation, (2) aerial radiation survey data consisting of exposure rates normalized to 3 feet above the ground plus gamma ray spectral charts, (3) effluent characterization for operational sites – intensity rates and isotope constituents, and (4) pertinent descriptive information of the installation. The data included and discussed in this report is considered to be the catalog file for the Dresden reactor site. The ARMS equipment and procedures employed to conduct this survey and evaluate the results are described in EG&G technical report 2 83–1457. 13 figs., 4 tabs.

**35035** (EGG–1183-1525) **Aerial Radiological Measuring Surveys (ARMS): Big Rock Point, August 1968.** Sevart, M.D. EG and G, Inc., Las Vegas, NV (United States). 13 Aug 1971. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018214. Source: OSTI; NTIS; GPO Dep.

The Aerial Radiological Measuring System (ARMS), operated for the US Atomic Energy Commission, was used to perform aerial surveys of several operational and non-operations reactor sites during the summer months of 1968. The data collected on the these surveys included aerial photographs of the installations, aerial radiation survey data consisting of exposure rates normalized to 3 feet above the ground plus gamma-ray spectral charts, effluent characterization for operational sites (intensity rates and isotope constituents), and pertinent descriptive information of the installation. This report presents the data collected on the Big Rock Point reactor survey. The Big Rock Point reactor site is located in North Central Michigan on the shoreline of Lake Michigan, 4 miles northeast of the community of Charlevoix. Currently operating at the site is a boiling water reactor with a capacity of 75 MW(E) (gross) owned and operated by Consumers Power Company. 6 figs., 3 tabs.

**35036** (EGG–1183-1565) **Snow gaging by airborne radiological surveys, status through September 1972.** Burson, Z.G.; Fritzsche, A.E. EG and G, Inc., Las Vegas, NV (United States). 1 Dec 1972. 57p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018213. Source: OSTI; NTIS; GPO Dep.

The real average of water equivalent of snow cover can be measured to an accuracy of $\pm$ 0.9 g/cm$^2$ or 6%, whichever is greater, using airborne radiation measurements of the natural gamma radiation emanating from the soil. The current state-of-the-art of this research program and the hydrologic interpretation are close to operational status. Both a gross count (counting of all photons) and a peak area (counts under the photopeak in the gamma energy spectrum) method are used. Improvements in both accuracy and spatial resolution should result from using a dual detector system

in which one detector preferentially "looks" up. to account for the airborne radiation daughter contributions. 16 refs.. 13 figs., 3 tabs.

**35037** (EGG–1183-1569) **Radiological survey of the area surrounding the Project GNOME Test Site, Carlsbad, New Mexico: Date of survey: 13 May 1972.** EG and G, Inc., Las Vegas, NV (United States). 14 Feb 1973. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018212. Source: OSTI; NTIS: GPO Dep.

The Aerial Radiological Measuring System (ARMS) was used to perform an aerial radiological survey of the Project Gnome Test Site and surrounding area during May 1972. The survey measured terrestrial background gamma radiation. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into a map of a four square mile area showing gamma exposure rates three feet above the ground. Results in general indicated the presence of isotopes normally found in the background radiation throughout the United States. However, trace amounts of cesium-137 were detected over a small area, later identified as a waste dump. 2 refs., 5 figs., 2 tabs.

**35038** (EGG–1183-1570) **Radiological survey of the area surrounding the Monticello Nuclear Generating Plant, Monticello, Minnesota: Date of survey: 21, 22 August 1970.** EG and G, Inc., Las Vegas, NV (United States). 14 Feb 1973. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018209. Source: OSTI; NTIS; GPO Dep.

The Aerial Radiological Measuring System (ARMS) was used to survey the Monticello Nuclear Generating Plant and surrounding area during August 1970. The survey measured terrestrial background gamma radiation. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into a map of a 625 square mile area showing isoexposure contours three feet above the ground. Results indicated the presence of isotopes normally found in the background radiation throughout the United States. 3 refs., 3 figs., 3 tabs.

**35039** (EGG–1183-1571) **Radiological survey of the area surrounding the Enrico Fermi Atomic Power Plant, Monroe, Michigan: Date of survey: 1 September 1970.** EG and G, Inc., Las Vegas, NV (United States). 23 Feb 1973. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018210. Source: OSTI; NTIS; GPO Dep.

The Aerial Radiological Measuring System (ARMS) was used to survey the Enrico Fermi Atomic Power Plant and surrounding area during September 1970. The survey measured terrestrial background gamma radiation and included a plume track of the stack release gases. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into a map of a 277 square mile area showing isoexposure contours three feet above the ground. Results indicated the presence of isotopes normally found in the background radiation throughout the United States. The plume track revealed no radiation above background levels. 3 refs., 3 figs., 3 tabs.

**35040** (EGG–1183-1573) **Radiological survey of the area surrounding the Shippingport Atomic Power Station Shippingport, Pennsylvania: Date of survey: 24 February 1973.** EG and G, Inc., Las Vegas, NV (United States). 9 Mar 1973. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018211. Source: OSTI; NTIS; GPO Dep.

The Aerial Radiological Measuring System (ARMS) was used to survey to Shippingport Atomic Power Station and surrounding area on February 24, 1973. The survey measured terrestrial background gamma radiation. Shippingport Station, operated by the Atomic Energy Commission and the Duquesne Light Company, is located near Shippingport, Pennsylvania. The size of the survey area was 530 square miles. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into a map of a 530 square mile area showing isoexposure contours three feet above the ground. Results indicated the presence of isotopes normally found in the background radiation throughout the United States. 4 refs.. 3 figs.. 3 tabs.

**35041** (EGG–1183-1578) **HAVE SINEW-1 recovery operation, August 1971.** EG and G. Inc.. Las Vegas, NV (United States). 16 Mar 1973. 10p. Sponsored by USDOE. Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018207. Source: OSTI; NTIS: GPO Dep.

The Aerial Radiological Measuring System (ARMS) participated during August 1971 in Project HAVE SINEW-1 at White Sands Missile Range. New Mexico. This project involved the flight of an Air Force Athena rocket carrying payloads which fell on the White Sands Range. The six payload packages contained a total of nine radioactive gamma sources as aids to recovery. The ARMS objective was to locate the sources from the air and to direct recovery crews to the impact sites. By means of the gamma detection equipment on board the ARMS aircraft. seven of the nine sources were quickly located. Of these, five were still attached to intact payload packages as expected; the other two were found detached from third payload. The remaining two sources were not found. It is believed that the payload(s) carrying the mission sources broke up in flight, causing them to fall uprange of the search area. 5 figs.

**35042** (EGG–1183-1586) **Radiological survey of the area surrounding the Nuclear Reactor Testing Station, Idaho Falls, Idaho: Date of survey: 1 and 2 February 1972.** EG and G, Inc., Las Vegas. NV (United States). 13 Apr 1973. 15p. Sponsored by USDOE, Washington. DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018208. Source: OSTI; NTIS; GPO Dep.

The Aerial Radiological Measuring System (ARMS) was used to survey the Nuclear Reactor Testing Station (NRTS) during February 1972. The purpose of the survey was primarily to identify the presence of Ru-106 ad Rh-106 from a suspected leak from the Central Processing Plan at NRTS. Additionally, the gamma-ray terrestrial exposure rate levels were to be mapped and the distribution of any man-made isotopes located and defined. The high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer-processed into a ma of a 330-sq-mi. area showing gamma isoexposure contours 3 ft above the ground. Exposure rates greater than natural terrestrial background radiation were found in the area surrounding reactor sites, waste dumps and the Chemical Processing Plant (CPP). The increased exposure rates appear to be caused by old fission products and some radioactive gases, possibly Ar-41, from normal reactor operations. The presence of Ru-106 and Rh-106 was not detected, indicating minimal leakage, if any, from the CPP. 2 refs., 5 figs., 2 tabs.

**35043** (EGG–1183-1594) **Radiological survey of the area surrounding the Haddam Neck Plant, Haddam Neck, Connecticut: Date of survey: 27, 28 August 1969.** EG and G, Inc., Las Vegas, NV (United States). 11 May 1973. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018206. Source: OSTI; NTIS; GPO Dep.

The Aerial Radiological Measuring System (ARMS) was used to survey the area surrounding the Haddam Neck nuclear power plant (Connecticut Yankee Reactor) during August 1969. The survey measured terrestrial gamma radiation. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer-processed into a map of a 900-square-mile area showing isoexposure contours three feet above the ground. Exposure rates and isotopes identified are consistent with normal terrestrial background radiation. 3 refs., 4 figs., 3 tabs.

**35044** (EGG–1183-1624) **Radiological survey of the McGuire Bomarc Site, New Jersey: Date of survey: November 1973.** EG and G, Inc., Las Vegas, NV (United States). 4 Mar 1974. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018195. Source: OSTI; NTIS; INIS; GPO Dep.

On November 12, 13 and 14, 1973, an aerial radiation survey was flown over a US Air Force deactivated Bomarc missile site near McGuire Air Force Base, New Jersey. The purpose of the

survey was to map $^{241}Am$ associated with weapons grade plutonium within and immediately adjacent to the site. Presence of the $^{241}Am$ was the result of a fire in one of the bunkers, which occurred in 1960. The aerial survey was conducted by EG&G, Inc., a contractor to the United States Atomic Energy Commission (AEC), Division of Operational Safety, at the request of the United States Air Force, Office of the Surgeon General. This equipment and contractor team are part of a special capability recently developed within the AEC Division of Military Applications, to rapidly evaluate radiological contamination in areas affected as the result of a Broken-Arrow situation. Standard military helicopters, with military pilots, provide the aerial platform. Installation of equipment requires a few hours under supervision of the contractor team. The spatial distribution of the $^{241}Am$ contamination on the terrain surface was measured using a large array of NaI gamma ray detectors, mounted on a helicopter. The data was acquired utilizing the REDAR (Radiation and Environmental Data Acquisition and Recorder) system. It was processed on the REDAC (Radiation and Environmental Data Analyzer and Computer) system. Measurements of both gamma ray count rate and energy spectra were made and correlated with the helicopter position data. Results are presented as isopleths giving the $^{241}Am$ surface concentration in units of $\mu g/m^2$. Measured values varied from background levels (< 0.04 $\mu g/m^2$ to between 0.43 $\mu g/m^2$ and 0.81 $\mu g/m^2$). Additionally, gamma energy spectra and intensity variations over the affected areas are presented. 16 figs., 1 tab.

**35045** (EGG–1183-1646) **Radiological survey of the area surrounding the H. B. Robinson S. E. Plant, Hartsville, South Carolina: Date of survey: 19–21 May 1973.** EG and G, Inc., Las Vegas, NV (United States). 4 Nov 1974. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018204. Source: OSTI; NTIS; INIS; GPO Dep.

The Aerial Radiological Measuring System (ARMS) was used to perform an aerial radiological survey of the area surrounding the H.B. Robinson S.E. Plant Reactor on 19 through 21 May 1973. The terrestrial background gamma radiation was measured during the survey. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into a map of a 625-square-mile area showing isopleths of the (3 ft above ground) gamma exposure rate. Results indicated the presence of natural radioelements normally found in the surface soil throughout the United States. Measured gamma exposure rates were mostly in the 4 to 8 $\mu$R/hr range, with maximum of 13 $\mu$R/hr. Ground based validation measurements, including in-situ radiological measurements and soil sample analysis, were made at three selected locations, confirming the presence of trace amounts of $^{137}Cs$ from worldwide fallout. Analysis of the surface soil geology is discussed relative to a correlation between the natural radioelement concentrations and the measured radioactivity. 18 refs., 5 figs., 6 tabs.

**35046** (EGG–1183-1647) **Radiological survey of the area surrounding the Brown's Ferry Nuclear Power Plant, Decatur, Alabama: Date of survey: 25 and 26 May 1973.** EG and G, Inc., Las Vegas, NV (United States). 5 Nov 1974. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018203. Source: OSTI; NTIS; INIS; GPO Dep.

The Aerial Radiological Measuring System (ARMS) was used to perform an aerial radiological survey of the area surrounding the Brown's Ferry Nuclear Power Plant on May 25 and 26, 1973. The terrestrial background gamma radiation was measured during the survey. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into a map of a 625-square-mile area showing isopleths of the (3 ft above ground) gamma exposure rate. Results indicated the presence of natural radioelements normally found in the surface soil throughout the United States. Measured gamma exposure rates were mostly in the 4 to 9 $\mu$R/hr range, with a maximum of 12 $\mu$R/hr. Ground based validation measurements, including in-situ radiological measurements and soil sample analysis, were made at two selected locations, confirming the presence of trace amounts of $^{137}Cs$ from worldwide fallout. Analysis of the surface soil geology is discussed relative to a correlation between the natural radioelement concentrations and the measured radioactivity. 20 refs., 5 figs., 6 tabs.

**35047** (EGG–1183-1649) **Radiological survey of the area surrounding the Calvert Cliffs Nuclear Power Plant, Lusby, Maryland: Date of survey: 8 and 9 June 1973.** EG and G, Inc., Las Vegas, NV (United States). Jul 1976. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018193. Source: OSTI; NTIS; INIS; GPO Dep.

The Aerial Radiological Measuring System (ARMS) was used to perform an aerial radiological survey of the area surrounding the Calvert Cliffs Nuclear Power Plant during June 8 and 9, 1973. The terrestrial background gamma radiation was measured during the survey. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into a map of a 512- square-mile area showing isopleths of the (3 ft above ground) gamma exposure rate. Results indicated the presence of natural radioelements normally found in the surface soil throughout the United States. Measured gamma exposure rates were mostly in the 2 to 8 $\mu$R/hr range, with a maximum of 13 $\mu$R/hr. Analysis of the surface soil geology is discussed relative to a correlation between the natural radioelement concentrations and the measured radioactivity. 7 refs., 5 figs., 3 tabs.

**35048** (EGG–1183-1657) **An aerial radiological survey of the area surrounding the Dresden Nuclear Power Plant, Morris, Illinois: Date of survey: September 1972.** Boyns, P.K. EG and G, Inc., Las Vegas, NV (United States). Jun 1978. 27p. Sponsored by USDOE, Washington, DC (United States); Nuclear Regulatory Commission, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018201. Source: OSTI; NTIS; INIS; GPO Dep.

The Aerial Measuring Systems (AMS) * was used to survey the area surrounding the Dresden Nuclear Power Plant during September 1972. The survey measured terrestrial gamma-ray exposure rate and spectral data. A high-sensitivity detection system collected gamma-ray spectral and gross count data. The data were then processed to construct a map of a 625 square mile area showing the spatial distribution of gamma-ray exposure rates 1 m above the ground. Exposure rates and isctopes identified are consistent with that related to normal terrestrial background radiation. The Dresden area was surveyed in 1968 and 1970. Comparison of the 1968 and 1970 surveys shows no measurable change in the terrestrial gamma exposure rates. Comparison of the 1968 ad 1970 surveys indicates a slight decrease in the average terrestrial exposure rate. 9 refs., 9 figs., 4 tabs.

**35049** (EGG–1183-1698) **Aerial radiological survey of the D.C. Cook Nuclear Plant (Bridgman, Michigan): Date of survey: September 1975.** EG and G, Inc., Las Vegas, NV (United States). Sep 1976. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018200. Source: OSTI; NTIS; INIS; GPO Dep.

An airborne radiological survey of an 1100 $km^2$ area surrounding the Donald C. Cook Reactor site was made between September 3 and September 6, 1975. Detected radioisotopes and their associated gamma ray exposures rates were consistent with that expected from the normal background emitters. Areal average exposure rates equivalent to one meter above the ground are presented in the form of an isopleth map. Exposure rates measured with small portable instruments and soil sample analysis showed excellent agreement with the airborne data. Geological data are presented in an isopleth map of rock and soil types; a brief description of the vegetation and terrain surrounding the site is also included. 8 refs., 4 figs., 2 tabs.

**35050** (EGG–1183-1708) **An aerial radiological survey of the area surrounding the Palisades Plant Nuclear Reactor Site (South Haven, Michigan): Date of survey: June 1976.** Boyns, P.K. EG and G, Inc., Las Vegas, NV (United States). Mar 1977. 15p. Sponsored by USDOE, Washington, DC (United States); Nuclear Regulatory Commission, Washington, DC (United States).

DOE Contract AC08-76NV01183. Order Number DE91018199. Source: OSTI; NTIS; INIS; GPO Dep.

An airborne radiological survey of an 1073 $km^2$ area surrounding the Palisades Plant nuclear reactor site was made on June 25, 1976. Detected radioisotopes and their associated gamma ray exposure rates were consistent with that expected from the normal background emitters. Aerial average exposure rates equivalent to one meter above the ground are presented in the form of an isopleth map. Exposure rates measured with small portable instruments and soil sample analysis showed excellent agreement with with airborne data. Geological data are presented in a map of glacial rock and soil types; a brief description of the terrain surrounding the site is also included. 8 refs., 4 figs., 2 tabs.

**35051** (EGG–1183-1715) **Snow water equivalent survey in the New York–Lake Ontario region: Dates of survey: February 26–March 1, 1977.** Fritzsche, A.E. EG and G, Inc., Las Vegas, NV (United States). Oct 1977. 41p. Sponsored by National Oceanic and Atmospheric Administration, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018198. Source: OSTI; NTIS; GPO Dep.

Thirty flight lines, including about 300 line miles, were flown during February 26, 1977 to March 1, 1977 to measure the water equivalent of snow in the Buffalo, Rochester and Syracuse areas of New York State. The method utilizing the attenuation by snow of natural terrestrial gamma rays was used. Water equivalents from less than one inch, between Rochester and Syracuse, to thirteen inches, east of Lake Ontario, were measured. Concentrated ground based measurements, using snow tubes, near Lake Owasco supported the airborne results. 3 refs., 2 figs., 2 tabs.

**35052** (EGG–1183-1728) **An aerial radiological survey of Argonne Site A, Palos Hills, Illinois: Date of survey: May 1976.** Jobst, J.E.; Houk, J.M.; Mohr, R.A. EG and G, Inc., Las Vegas, NV (United States). Jun 1978. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018197. Source: OSTI; NTIS; INIS; GPO Dep.

An aerial radiological survey was conducted over the original site of Argonne National Laboratory, viz, Argonne Site A, and over the associated radiological waste dump, Plot M. These areas are 5 km east of the present Laboratory. The survey was performed at an altitude of 30 m on 31 May 1976 using sodium iodide detectors mounted in a helicopter. The 2 $km^2$ aerial survey showed gamma radiation due to naturally occurring radioisotopes in the soil and due to low level concentrations of $^{137}Cs$. Subsequent soil samples showed low levels of tritium and $^{137}Cs$ near Plot M. Soil samples from Site A showed low levels of $^{137}Cs$, $^{60}Co$, and other isotopes. The data was acquired utilizing the REDAR (Radiation and Environmental Data Acquisition and Recorder) system. It was processed on the REDAC (Radiation and Environmental Data Analyzer and Computer) system. This survey was authorzed by the United State of Energy (DOE) and conducted by EG&G. 11 refs., 17 figs., 7 tabs.

**35053** (EGG-M–89238) **Modeling potential migration of petroleum hydrocarbons from a mixed-waste disposal site in the vadose zone.** Rawson, S.A.; Walton, J.C.; Baca, R.G. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1989]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-8911162–1: NWWA/API conference on petroleum hydrocarbons and organic chemicals in ground water, Houston, TX (United States), 15-17 Nov 1989). Order Number DE91018694. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental monitoring of a mixed-waste disposal site at the Idaho National Engineering Laboratory has confirmed release and migration into the vadose zone of: (1) chlorinated hydrocarbons in the vapor phase and (2) trace levels of certain transuranic elements. The finding has prompted an evaluation of the potential role of waste petroleum hydrocarbons in mediating or influencing contaminant migration from the disposal site. Disposal records indicate that a large volume of machine oil contaminated with transuranic isotopes was disposed at the site along with the chlorinated solvents and other radioactive wastes. A multiphase flow model was used to assess the possible extent of oil and vapor movement through the 177 m thick vadose zone. One dimensional simulations were performed to estimate the vertical distribution of the vapor phase, the aqueous phase, and immiscible free liquid as a function of time. The simulations indicate that the oil may migrate slowly through the vadose zone, to potentially significant depths. Calculated transport rates support the following ranking with regard to relative mobility: vapor phase > aqueous phase > free liquid. 21 refs., 7 figs., 2 tabs.

**35054** (EGG-M–90460) **Influence of natural convection on melt shape during in situ vitrification.** Hawkes, G.L. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-910739–28: ASME/AIChE/ANS national heat transfer conference, Minneapolis, MN (United States), 26-31 Jul 1991). Order Number DE91018750. Source: OSTI; NTIS; INIS; GPO Dep.

A study of natural convection during In Situ Vitrification (ISV) is presented. ISV is a hazardous waste remediation process in which contaminated soil and/or buried waste is treated in place by direct application of electrical power to the contaminated region via submerged electrodes. The magnitude of the resulting electrical resistance heating is sufficient to cause soil melting. As the molten region grows, natural convection motion of the molten soil occurs. This paper presents numerical results obtained by considering natural convection melting when solving the strongly coupled momentum and energy equations using finite element methods. A local heat source is calculated by solving the electric field equation and calculating a Joule Heat source term. Melt shapes obtained from runs with various values of the coefficient of volume expansion ($\beta$) in the buoyancy terms of the momentum equations are presented. Results of a pure conduction model are also presented. The melt fronts calculated from the fluid flow model melt more uniformly downward, whereas the melt front from the conduction model melts faster in the center and slower near the electrodes. Melt volumes for all models are approximately the same for a specified time period. 3 refs., 11 figs.

**35055** (EGG-WTD–9736) **Particle characterization of contaminated soil.** Miller, J.D.; Hupka, J.; Weidner, J.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). May 1991. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018830. Source: OSTI; NTIS; INIS; GPO Dep.

Samples collected from Test Reactor Area Warm Waste Pond sediments at the Idaho National Engineering Laboratory were characterized in the test facilities in the Metallurgy Department, University of Utah. The sediments were characterized in terms of several physical, chemical, and mineralogical properties judged to be most important for separating radioactive materials and hazardous metals from the sediment matrix. The properties include particle size, distribution, effects of heating at 600°C, electrophoretic properties, magnetic separation, acid leaching, and analyses using ultra-violet light, infra-red, and x-ray diffraction. The results show that most radioactive and hazardous metals are present in the $\leq$ 150 micron size fraction and that 80% of the sediments occur in the $\geq$ 150 micron size fraction. No significant concentration of hazardous metals was found to be related to magnetic properties. Organic matter, probably as a thin film, was shown to be present. The mineralogy of the samples include quartz, chlorite, kaolinite, illite, calcite, and dolomite. 3 refs., 17 figs., 5 tabs.

**35056** (EGG-WTD–9749) **Characterization studies on: (A) Contaminated batch of Rocky Flats soil (B) Uncontaminted batch of INEL soil.** Lee, Jae-Ho; Martins, G.P.; Weldner, J.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jun 1991. 50p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018785. Source: OSTI; NTIS; INIS; GPO Dep.

Transuranic waste (TRU) contaminated soil samples collected near Rocky Flats 903 Pad and uncontaminated INEL soil collected from the Lost River spreading area A adjacent to the Radioactive Waste Management Complex were characterized in the analytical facilities of the Department of Metallurgical and Materials Engineering, Colorado School of Mines. The soils were characterized in terms of chemical, physical and mineralogical properties judged to be important for separating hazardous materials from the soil matrix. These properties include particle size distribution, density

measurements, determination of micro-morphology, micro-chemical analysis, cation exchange capacity, and mineralogical and chemical analysis. The results indicate that the two soils are distinctly different from one another, but share some features. Rocky Flats soils contain about 47 wt% quartz, 38 wt% clay minerals, 13 wt% feldspars, and minor constituents. INEL soil contains about 37 wt% quartz, 48 wt% clay minerals, 10 wt% calcite, and minor constituents. The cation exchange capacities of each soil are low and are approximately the same when ashed. The radioactivity, relative to unclassified soil, as a function of particle size suggests that TRU metals are concentrated by a factor of approximately 20% in the less than 300 $\mu$m particle size fraction. 29 figs.

**35057** (EUR–13262) **Study of the radionuclides contained in wastes produced by the phosphate industry and their impact on the environment.** Baetsle, L.H. (Centre d'Etude de l'energie nucleaire, Mol (BE)). Commission of the European Communities, Luxembourg (Luxembourg). 1991. 83p. Contract ETCC-0006. Source: OSTI; NTIS (US Sales Only).

This report reviews the present state of the management and disposal of waste associated with mining, milling and reprocessing of phosphate ores with regard to its content on naturally occurring radionuclides. The main areas of investigation are: phosphate ores and their characteristics and phosphate trade in the Member States of the European Community, production and processing methods of phosphoric acids and phosphates, interaction of phosphate products and wastes with the environment, standards and regulations for radioactivity released during processing in the phosphate industry.

**35058** (EUR–13280) **The uranium source-term mineralogy and geochemistry at the Broubster natural analogue site, Caithness.** Milodowski, A.E. (British Geological Survey, Keyworth, (UK)); Pearce, J.M.; Basham, I.R.; Hyslop, E.K. Commission of the European Communities, Luxembourg (Luxembourg). 1991. 50p. Contract FI1W/0073 UK. Source: OSTI; NTIS (US Sales Only).

The British Geological Survey (BGS) has been conducting a co-ordinated research programme at the Broubster natural analogue site in Caithness, north Scotland. This work on a natural radioactive geochemical system has been carried out with the aim of improving our confidence in using predictive models of radionuclide migration in the geosphere. This report is one of a series being produced and it concentrates on the mineralogical characterization of the uranium distribution in the limestone unit considered as the 'source-term' in the natural analogue model.

**35059** (EUR–13315) **Application and validation of predictive computer programs describing the chemistry of radionuclides in the geosphere.** Waters, M. (University Coll., Cardiff (UK)); Duffield, J.R.; Griffiths, P.J.F.; Williams, D.R. Commission of the European Communities, Luxembourg (Luxembourg). 1991. 138p. Contract FI1W/0077 (UK). Source: OSTI; NTIS (US Sales Only).

Chemval is an international project concerned with improving the data used to model the speciation chemistry of radionuclide migration from underground waste disposal sites. Chemval has two main aims: to produce a reliable database of thermodynamic equilibrium constants for use in such chemical modelling; to perform a series of test-case modelling exercises based upon real site and field data to verify and validate the existing tools used for simulating the chemical speciation and the transport of radionuclides in the environment.

**35060** (KFK-PEF–85) **The chemical analysis of undisturbed forest soil cores - methods and results.** Hildebrand, E.E. (Forstliche Versuchs- und Forschungsanstalt Baden-Wuerttemberg, Freiburg im Breisgau (Germany, F.R.). Abt. Bodenkunde und Waldernaehrung). Kernforschungszentrum Karlsruhe GmbH (Germany). Projekt Europaeisches Forschungszentrum fuer Massnahmen zur Luftreinhaltung (PEF). Jul 1991. 205p. (In German). Contract PEF 87/006/1A. Order Number DE92714349. Source: OSTI; NTIS (US Sales Only).

The structure of forest soils contains chemical information, which is important for tree growth. For this reason empirical methods were developed, which allow to circumvent the homogenisation of soil samples thus avoiding a loss of chemical information. The methods and the additionally obtained information are discussed. (orig.) With 83 figs., 3 tabs., 124 refs.

**35061** (LBL–29689) **Hydrological and geochemical investigations of selenium behavior at Kesterson Reservoir: Annual report, October 1, 1989–September 30, 1990.** Benson, S.M.; Tokunaga, T.K.; Zawislanski, P.; Yee, A.W.; Daggett, J.S.; Oldfather, J.M.; Tsao, L.; Johannis, P.W. Lawrence Berkeley Lab., CA (United States). Oct 1990. 206p. Sponsored by Department of the Interior, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000687. Source: OSTI; NTIS; GPO Dep.

From 1985 to the present we have studied the behavior of selenium in various habitats and environments at Kesterson reservoir, shifting emphasis as remedial actions altered the physical setting. Investigations have evaluated the efficacy of several remedial alternatives, from innovative techniques relying on the complex geochemical behavior of selenium alternatives, from innovative techniques relying on the complex geochemical behavior of selenium in aquatic environments to conventional excavation schemes. Results of these studies supported two cost-effective remedial measures; drain water deliveries were terminated in 1986 and, in 1988, 1 million cubic yards of soil were imported and used to fill the low lying areas of the former Kesterson Reservoir. To date, these two actions appear to have eliminated the aquatic habitat that caused waterfowl death and deformity at Kesterson from the early 1980's to 1987. Biological, surface water and groundwater monitoring data collected by the USBR indicate that Kesterson is now a much safer environment than in past years when drainage water containing 300$\mu$g/l of selenium was delivered to the Reservoir. The continued presence of a large inventory of selenium within the upper portions of unfilled areas of Kesterson Reservoir and immediately below the fill material requires that a continued awareness of the status of this inventory be maintained and improved upon. 83 refs., 130 figs., 19 tabs.

**35062** (LBL–30758) **STMVOC User's Guide.** Falta, R.W.; Pruess, K. Lawrence Berkeley Lab., CA (United States). Jun 1991. 129p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000721. Source: OSTI; NTIS; GPO Dep.

This report contains instructions for using the STMVOC numerical simulator. This code, which was developed at Lawrence Berkeley Laboratory, is an extension of the TOUGH geothermal code for use in problems involving subsurface contamination by nonaqueous phase liquids (NAPLs). The code is used for modeling the non-isothermal transport of air, water, and an organic chemical in three fluid phases. A discussion of the physical processes included in the simulator is given along with a brief outline of the mathematical formulation. A detailed guide to preparing the STMVOC input file with several illustrative examples is provided. 22 refs., 27 figs., 3 tabs.

**35063** (PNL–7787) **Soil washing: A preliminary assessment of its applicability to Hanford.** Gerber, M.A.; Freeman, H.D.; Baker, E.G.; Riemath, W.F. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 84p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE91018654. Source: OSTI; NTIS; GPO Dep.

Soil washing is being considered for treating soils at the US Department of Energy's (DOE) Hanford Site. As a result of over 50 years of operations to produce plutonium for the US Department of Defense and research for DOE, soils in areas within the Site are contaminated with hazardous wastes and radionuclides. In the soil washing process, contaminated soil is mixed with a liquid and then physically and/or chemically treated to dissolve the contaminants into solution and/or concentrate them in a small fraction of the soil. The purpose of this procedure is to separate the contaminants from the bulk of the soil. The key to successful application is to match the types of contaminants and soil characteristics with physical-chemical methods that perform well under the existing conditions. The applicability of soil washing to Hanford Site contaminated soils must take into account both the characteristics of the oil and the type of contamination. Hanford soils typically contain up to 90% sand, gravel, and cobbles, which generally are favorable characteristics for soil washing. For example, in soil samples from the north pond in the 300 Area, 80% to 90% of the soil particles were larger

than 250 μm. The principal contaminants in the soil are radionuclides, heavy metals, and nitrate and sulfate salts. For most of the sites, organic contaminants are either not present or are found in very low concentration. 28 refs., 5 figs., 10 tabs.

**35064** (PNL–7790) **Dungeness crab survey for the Southwest Ocean Disposal Site off Grays Harbor, Washington, June 1990.** Higgins, B.J. (Battelle/Marine Sciences Lab., Sequim, WA (United States)); Pearson, W.H. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 37p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC06-76RL01830. Order Number DE92000165. Source: OSTI; NTIS; GPO Dep.

As part of the Grays Harbor Navigation Improvement Project, the Seattle District of the US Army Corps of Engineers has begun active use of the Southwest Ocean Disposal Site off Grays Harbor, Washington. This survey was to verify that the location of the area of high crab density observed during site selection surveys has not shifted into the Southeast Ocean Disposal Site. In June 1990, mean densities of juvenile Dungeness crab were 146 crab/ha within the disposal site and 609 crab/ha outside ad north of the disposal site. At nearshore locations outside the disposal site, juvenile crab density was 3275 crab/ha. Despite the low overall abundance, the spatial distribution of crab was such that the high crab densities in 1990 have remained outside the Southwest Ocean Disposal Site. The survey data have confirmed the appropriateness of the initial selection of the disposal site boundaries and indicated no need to move to the second monitoring tier. 8 refs., 9 figs., 2 tabs.

**35065** (PNL-SA–19469) **Soil washing results for mixed waste pond soils at Hanford.** Gerber, M.A. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-910981–17: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE92000147. Source: OSTI; NTIS; INIS; GPO Dep.

Soil washing technology was assessed as a means for remediating soil contaminated with mixed wastes primarily composed of heavy metals and radionuclides. The soils at the US Department of Energy's Hanford Site are considered suitable for soil washing because of their relatively low quantities of silt and clay. However, in a limited number of soil washing experiments using soils from different locations in the north pond of the 300 Area, the degree of decontamination achieved for the coarse fraction of the soil varied considerably. Part of this variation appears to be due to the presence of a discrete layer of contaminated sediment found in some of the samples. 7 refs., 2 figs., 4 tabs.

**35066** (SERI/CP–250-4254-Vol.2, pp. 19-34) **Site considerations for Solar Detoxification Project at LLNL.** Boegel, A.J. (Lawrence Livermore National Lab., CA (USA)); Merrill, T. Solar Energy Research Inst., Golden, CO (United States); Sandia National Labs., Albuquerque, NM (United States). Apr 1991. (CONF-9103109–Vol.2: SOLTECH '91 conference, Burlingame, CA (United States), 26-29 Mar 1991). In *SOLTECH 91: Proceedings. Volume 2*. 317p. Order Number DE91013767. Source: OSTI; NTIS.

Solar technology for environmental applications has been studied under laboratory conditions by many groups. However, an actual contaminated site has many characteristics that can complicate any cleanup operation and must be adequately addressed here before commercialization is possible. These characteristics include the amount and type of contamination, the regulatory requirements, and the effects of other ground water constituents. The laboratory results need to be compared with field results using the same equipment. The Solar Detoxification Project at LLNL is a collaborative effort by three national laboratories [Solar Energy Research Institute (SERI), Sandia National Laboratory (SNL), and Lawrence Livermore National Laboratory (LLNL)] to take this solar technology out of the laboratory and into the field to detoxify contaminated ground water under actual field conditions. LLNL is the site of this experiment for many reasons. It is a Superfund site already well-characterized. The experiment can be included under existing permits. The existence of permitted LLNL ground water treatment systems makes it possible to perform a technology evaluation of this magnitude. The experimental solar detox facility will be installed in series with an existing permitted treatment facility such that any contaminants remaining in the ground water following detoxification experiments with the solar unit will then be treated by the LLNL facility. LLNL has experience with and has evaluated several related treatment technologies. The project will provide an opportunity for broad experimentation on system variables that will lead to improved system designs and techniques for contaminated ground water remediation.

**35067** (VTT-TIED–1212) **Cost-efficiency of measures to reduce sulphur deposition.** Lehtilae, A. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Ydinvoimatekniikan Lab.); Savolainen, I.; Tuovinen, J.P. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1991. 49p. (In Finnish). Order Number DE92704018. Source: OSTI; NTIS (US Sales Only).

In the calculation scheme the transport of sulphur emissions has been estimated by using two models. For longer distances the results of the EMEP long-range transport model have been applied, whereas for shorter distances the mesoscale deposition model developed by the Finnish Meteorological Institute has been adopted. The amount of background deposition originating from either natural sources or from unidentifiable human sources (coming from or going through non-European areas) has been carefully judged. The cost data used in the calculations include the estimated costs of two different emission reduction technologies as well as the costs of fuel switching for each large scale energy conversion plant in Finland. Furthermore, the costs for reducing process emissions from the major $SO_2$-emitting industrial sectors have been rough calculated. For each of the Finnish provinces and the nearby Soviet regions cost functions of emission reductions have been constructed. Cost functions for other European countries have been obtained from the IIASA (International Institute for Applied Systems Analysis) Rains model. The results of the calculations indicate that even if the most cost-effective measures can be taken in southern Finland and in Kola, soon measures in other Soviet nearby regions should be considered having a high priority, too. Significant reductions in deposition levels can, however, be achieved only through marked abatement of emissions in central and eastern Europe.

**35068** (VYH-JULK–A66) **The use of chlorinated paraffins and their possible effects in the environment.** Mukherjee, A.B. National Board of Waters and the Environment, Helsinki (Finland). 1990. 56p. Order Number DE92703993. Source: OSTI; NTIS (US Sales Only).

This survey is an overview of the current state of knowledge in Finland concerning chlorinated paraffins (CPs). Commercially, more than 200 types of CPs have been reported. The carbon chain length and chlorine percentage varies in the different types of CPs. Due to their favourable properties, CPs have a multitude applications. CFs are not produced in Finland but they are imported. In 1988 about 840 tons were consumed by paper, plastic, paint and metal industries in Finland. Due to lack-of an adequate analytical method, the route of CPs to the Finnish environment is still unknown. It is believed that due to their low water solubility, CPs are bound to products or end up at landfills. Because only minor quantities of CPs are transported to waste incineration plants or steel industry as scrap metal, emissions formed in these processes are insignificant. The toxicity of CPs depends on carbon chain length and the degree of chlorination. By certain standard tests, carcinogenesis of CPs has been indicated.

**35069** (VYH-JULK–A67) **Environmental impacts of hazardous wastes in landfills.** Assmuth, T.; Poutanen, H.; Strandberg, T.; Melanen, M.; Penttilae, S.; Kirsti, K. National Board of Waters and the Environment, Helsinki (Finland). 1990. 214p. (In Finnish). Order Number DE92703995. Source: OSTI; NTIS (US Sales Only).

The environmental impacts and risks caused by hazardous wastes disposed in Finnish landfills were assessed on the basis of a five year field study of 43 landfills. The experimental investigations were concentrated on the chemical quality and toxicity of surface water runoff from municipal solid waste landfills. Additionally, measurements have been made of the quality of waste deposits, landfill gas, ground water and soil. The main results of the research are presented and thoroughly discussed in this report, e g. by comparing them with published reference data. General conclusions are drawn on the basis of the analyses concerning the

environmental impacts and risks of hazardous wastes in Finnish landfills, and recommendations are given for their assessment and management.

35070 (WHC-SA-1289) **A comparison of three methods for solving flow equations of two immiscible fluids in variably saturated media.** Piepho, M.G. (Westinghouse Hanford Co., Richland, WA (United States)); Runchal, A.K. Westinghouse Hanford Co., Richland, WA (United States). Jul 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-911244-1: 3. symposium on multiphase transport in porous media. Atlanta, GA (United States), 1-6 Dec 1991). Order Number DE91016945. Source: OSTI; NTIS; GPO Dep.

Three alternate methods are compared for numerically solving the coupled flow equations for two immiscible fluids in variably saturated media. The three alternate methods are (1) the Picard method, (2) the logmean method, and (3) a modified Picard method. All three methods were used to simulate an experiment with transmission oil infiltrating sand. Different time-step sizes were used for each method, and mass-balance accuracy is compared for each time-step size and method at various time values during the transient infiltration. Also, simulated contours of oil mass, using the modified Picard method, are compared to the experimental contours. 7 refs., 4 figs.

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*Refer also to citation(s) 33798, 33802, 33810, 33876, 33891, 33892, 33893, 33894, 33895, 33896, 33897, 33898, 34059, 34230, 34231, 34232, 34233, 34400, 34805, 35014, 35022, 35026, 35027, 35028, 35053, 35057, 35067, 35068, 35069, 35145, 35533*

35071 (CIEMAT-641) **Temporal distribution of Pu and Am in the marine environment of southern coast of Spain.** Iranzo, E.; Gascon, C.; Romero, L.; Martinez, M.; Mingarro, E.; Rivas, P. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1989. 43p. Order Number DE92700002. Source: OSTI; NTIS (US Sales Only).

The distribution of trasuranides and Cs-137 in selected sediment cores from southern Spanish coast has been studied. The area is of special interest as an accidental release of transuranides (four nuclear bombs fallen down) occured near the seaside in 1966 (Palomares). The possible transference to the coast by the river (contaminated by one bomb, surface contamination: 12-120 alpha Bq/m2) or by aerosol produced in the explosion had never been estudied. Several sediments cores between Cape of Palos ands Cape of Gata and surface sediments were raised. The profiles of transuranides distribution were determined and were dated in order to determine the year of the contributions. An enhanced concentration of transuranides has been observed at southern area of Palomares coast, the causes of this phenomena have been analyzed in this paper. The accuracy of radiochemical analysis was checked by analyzing standard material and duplicated samples. (Author)

35072 (CONF-9010383-1) **Mercury in aquatic ecosystems.** Blaylock, B.G. Oak Ridge National Lab., TN (United States). [1990]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From BIOMOVS (biosperic model validation study) symposium on the validity of environmental transfer models; Stockholm (Sweden); 8-10 Oct 1990. Order Number DE91018844. Source: OSTI; NTIS; GPO Dep.

This document contains the introduction and conclusions from the talk presented by Gordon Blaylock at BIOMOVS, Proceedings on the Validity of Environmental Transfer Models, held in Stockholm, Sweden in October 1990. This paper provides a broad background for the testing of BIOspheric MOdel Validation Studies (BIOMOVS) models, and discussed three type A models and how their predictions match actual concentrations in the environment. For situations were mercury is near equilibrium, simple models based on distribution coefficients ($K_d$) or concentration factors (both of which are derived from equilibrium values) predict actual concentrations best, but when concentrations are not near equilibrium, these models perform much worse than complex models. Therefore, caution should be used in choosing the model used to analyze specific situations (MHB)

35073 (CONF-910981-9) **A co-metabolic approach to groundwater remediation.** Palumbo, A.V. (Oak Ridge National Lab., TN (United States)); Boerman, P.A.; Strandberg, G.W.; Donaldson, T.L.; Jennings, H.L.; Lucero, A.J.; Herbes, S.E.; Phelps, T.J.; White, D.C. Oak Ridge National Lab., TN (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Environmental remediation '91 conference: Pasco, WA (United States): 8-11 Sep 1991. Order Number DE92000063. Source: OSTI; NTIS; INIS; GPO Dep.

In support of the US Department of Energy's (DOE) Integrated Demonstration (Cleanup of Organics in Soils and Groundwater at Non-arid Sites) at the Savannah River Site (SRS), Oak Ridge National Laboratory (ORNL) and the University of Tennessee (UT) are involved in demonstrations of the use of methanotrophs in bioreactors for remediation of contaminated groundwater. In preparation for a field demonstration at ORNL's K-25 Site in Oak Ridge, Tennessee, ORNL is conducting batch experiments, is operating a number of bench-scale bioreactors, has designed pretreatment systems, and has modified a field-scale bioreactor provided by the Air Force Engineering and Services Center for use at the site. UT is operating bench-scale bioreactors with the goal of determining the stability of a trichloroethylene-degrading methanotrophic consortia during shifts in operating conditions (e.g. pH, nutrient inputs, and contaminant mixtures). These activities are all aimed at providing the knowledge base necessary for successful treatment of contaminated groundwater at the SRS and K-25 sites as well as other DOE sites. 18 refs., 1 fig. , 1 tab.

35074 (CONF-910981-12) **Evaluation of proposed designs for streamflow monitoring structures at waste disposal sites.** Clapp, R.B.; Borders, D.M.; Tardiff, M.F.; Huff, D.D. Oak Ridge National Lab., TN (United States). [1991]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Environmental remediation '91 conference; Pasco, WA (United States); 8-11 Sep 1991. Order Number DE92000064. Source: OSTI; NTIS; GPO Dep.

Design of small surface water monitoring stations associated with waste sites requires an approach that balances several problems. The monitoring site must have a capacity for a wide range of flows, allow accurate measurements over the full performance range, minimize effects from accumulation of contaminated sediments, and minimize costs of construction and operation. Selecting a station design that takes these factors into consideration can be done systematically through use of formal decision analysis. The paper discusses the effectiveness of various hydraulic structures as flumes and weirs to monitor stream flow and drainage. The process has produced the most viable alternative designs and yielded fully documented guidelines for designing new stations as they are needed. 7 refs., 6 figs., 3 tabs.

35075 (DOE/ID-22096) **Hydrologic conditions and distribution of selected chemical constituents in water, Snake River Plain aquifer, Idaho National Engineering Laboratory, Idaho, 1986 to 1988.** Orr, B.R. (Geological Survey, Idaho Falls, ID (United States). Water Resources Div.); Cecil, L.D. Department of Energy, Idaho Falls, ID (United States). Idaho Operations Office; Geological Survey, Idaho Falls, ID (United States). Water Resources Div. Mar 1991. 61p. Sponsored by USDOE, Washington, DC (United States); Department of the Interior, Washington, DC (United States). (USGS-WRI-91-4047). Order Number DE91018691. Source: OSTI; NTIS; INIS; GPO Dep.

Detectable concentrations of radionuclide- and chemical-waste constituents in water from the Snake River Plain aquifer at the Idaho National Engineering Laboratory decreased during 1986–1988. Decreased radionuclide concentrations are attributed to reduced rates of radionuclide-waste disposal, sorption processes, radioactive decay, dilution from recharge, and changes in waste-disposal practices. Tritium concentrations in aquifer water and strontium-90 concentrations decreased. Cobalt-60 and cesium-137 concentrations exceeded the reporting level in water from only one well during 1986–1988. in 1988, concentrations of plutonium-238 and plutonium-239, -240 (undivided) in water from the Test Area

North disposal well were 0.19 ± 0.05 pCi/L and O.96 ± 0.08 pCi/L, respectively. The concentration of plutonium-238 in well CFA-1 was 0.11 ± 0.03 pCi/L in 1987. In subsequent samples, concentrations were less than the reporting level. Sodium, chloride, and nitrate plumes originating from the Idaho Chemical Processing Plant decreased in size since use of the ICPP disposal well was discontinued in 1984. During 1986–1988, the approximate areal extent of the sodium plume decreased from 6.8 to 2.5 square miles, the chloride plume decreased from 17 to 5.2 square miles, and the nitrate plume decreased from 14 to 5 square miles. In 1987, water from wells 65 and 89 contained 280 and 50 μg/L, respectively, of chromium; other water samples contained from less than 1 to 30 μg/L. 52 refs., 17 figs., 3 tabs.

**35076** (DOE/RL–91-47) **Quarterly report of RCRA groundwater monitoring data for period April 1, 1991 through June 30, 1991.** USDOE Richland Operations Office, WA (United States); Westinghouse Hanford Co., Richland, WA (United States). Geosciences Group. Sep 1991. 58p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000244. Source: OSTI; NTIS; INIS: GPO Dep.

Hanford Site interim-status groundwater monitoring projects are conducted as either background, indicator parameter evaluation, or ground water quality assessment monitoring programs as defined in the Resource Conservation and Recovery Act of 1976 (RCRA); and 40 CFR 265, Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, as amended (EPA 1989). Compliance with the 40 CFR 265 regulations are required by the Washington Administrative Code 173–303 (Ecology 1991). This submittal provides data obtained from groundwater monitoring activities for April 1, 1991 through June 30, 1991. 12 refs., 1 fig., 12 tabs.

**35077** (ENET–8900424/3) **Temperature of groundwater and plant-growth in Utzenstorf-Aefligen. Short report: Period of investigation 1985-1988.** Borcard, D.; Fluehler, H.; Matthey, W.; Nanz, M.; Oberholzer, M.; Richner, G.; Schwendimann, F.; Werner, A. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Apr 1989. 59p. (In German). Order Number DE92714225. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH).

This report deals with the effects of the cooling of the groundwater, caused by heat pumps, on plant-growth. There is no effect where the groundwater table is deep but the situation has not yet been clarified where the groundwater table is high. The dependency between ground and groundwater temperatures was investigated in extensive field experiments. The nine locations where experiments were carried out included 6 agricultural areas and 3 forest areas. At five of the locations the distance between the surface and the groundwater table was smaller than 1.5 m, therefore the root area was close to the groundwater table. At 4 locations the groundwater table was 3.6 m underground. Different results were achieved, the most important one being that no indication was found that the cooling of the groundwater jeopardises the agricultural yields, if the groundwater table lies below the root area, i.e. depending on the soil conditions ca. 2 m below the surface of the ground. 25 figs., 5 tabs., 5 refs.

**35078** (ETDE-mf–2704574) **Program of the Land of Hessen for surface water quality assessment. Flowing water. Measurements and evaluations 1989.** Umweltplanung, Arbeits- und Umweltschutz. Fesel, U.; Rosen, G. Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany). 1990 277p. (In German). Order Number DE92704574. Source: OSTI; NTIS (US Sales Only).

In the framework of the Hessen surface water quality measuring program, 57 measuring stations were installed in flowing bodies of water. Chemical and physical analyses of water samples from these points were carried out at regular intervals in order to assess the water quality. The results are compiled, evaluated, and compared with the findings of earlier years in this report. (BBR).

**35079** (KFK–4869) **Environmental research in the former GDR in the 80ies and promotion measures following German unification.** Coenen, R.; Schmitt, J.J. Kernforschungszentrum Karlsruhe GmbH (Germany). Abt. fuer Angewandte Systemanalyse. May 1991. 23p. (In German). Order Number DE92714343. Source: OSTI; NTIS (US Sales Only).

A brief description of the deficits in environmental policy and of the, in parts, catastrophic environmental pollution situation in the former GDR, is followed by an analysis of the GDR's promotion of environmental research during the 80ies. The analysis of research statistics highlights the completely inadequate promotion given to the environmental field. The report continues with a description of the measures to promote environmental research following German unification. (orig.).

**35080** (NIRS-RSD–92) **Radioactivity survey data in Japan, part 1. Environmental materials.** National Inst. of Radiological Sciences, Chiba (Japan). Apr 1991. 32p. Order Number DE92704017. Source: OSTI; NTIS (US Sales Only); INIS.

The publication is aimed at providing radioactivity survey data in environmental and dietary materials in Japan. Part 1 covers environmental materials, consisting of rain and dry fallout, airborne dust, service water, freshwater, soil, sea water, and sea sediments. Samples were collected from 42 sampling locations during the period between July 1989 and July 1990, and were sent to the Japan Chemical Analysis Center for radiochemical analysis. Strontium 90 and cesium 137 in these environmental materials are tabulated. The maximum concentrations of strontium-90 and cesium-137 were as follows: 0.17+-0.100 MBq/Km$^2$ and 0.30+-0.030 MBq/Km$^2$, respectively, for rain and dry fallout (domestic program); 0.16+-0.031 MBq/Km$^2$ and 0.31+-0.031 MBq/Km$^2$ for rain and dry fallout (WHO program); 0.003+-0.0017 mBq/m$^3$ and 0.005+-0.0012 mBq/m$^3$ for airborne dust; 4.9+-0.29 mBq/l and 0.6+-0.11 mBq/l for service water; 5.0+-0.26 mBq/l and 0.5+-0.10 mBq/l for freshwater; and 18+-0.5 Bq/Kg and 110+-1.0 Bq/Kg for dried soil. Yearly changes in the concentrations of both strontium-90 and cesium-137 from 1986 through 1990 are given in figures. (J.P.N.).

**35081** (ORNL/ER–17) **Treatability study for WAG 6 (SWSA 6) trench water.** Taylor, P.A. Oak Ridge National Lab., TN (United States). Aug 1991. 61p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000418. Source: OSTI; NTIS; INIS; GPO Dep.

The Environmental Restoration Program at Oak Ridge National Laboratory (ORNL) is examining methods for remediation and final closure of Waste Area Grouping 6 (WAG 6) under a Resource Conservation and Recovery Act (RCRA) closure plan. WAG 6 consists primarily of Solid Waste Storage Area 6 (SWSA 6), where solid low- level radioactive waste (and some hazardous waste) was buried from 1968 to 1985 in shallow trenches. To support the feasibility study that is being prepared for closure of WAG 6, lab-scale treatability tests were performed on the water from selected trenches in SWSA 6 to determine if the trench water could be treated at the existing wastewater treatment plants at ORNL. Water from 23 of the 500 trenches in SWSA 6 has been sampled and analyzed to date, and the 4 most highly contaminated trenches identified thus far supplied the water used in the treatability tests. The softening and ion-exchange processes used in the Process Wastewater Treatment Plant (PWTP) reduced the $^{90}$Sr concentration, which was the only radionuclide present in the trench water at above the discharge limits, from 260 to 0.2 Bq/L. The air stripping and activated carbon adsorption processes used in the Nonradiological Wastewater Treatment Plant (NRWTP) removed volatile and semivolatile organics (mostly toluene, xylene, and naphthalene), which were the main contaminants in the trench water, to below detection limits. The trench water treated in the lab-scale equipment easily met all discharge limits for the PWTP and the NRWTP. 6 refs., 2 figs., 9 tabs.

**35082** (ORNL/M–1156) **Environmental surveillance data report for the third quarter of 1990.** Goldberg, P.Y.; Osborne-Lee, A.E.; Powell, M.R.; Stevens, M.M.; Tardiff. M.F.; Valentine, C.K.; Wolf, D.A. Oak Ridge National Lab., TN (United States). Jul 1991. 77p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000422. Source: OSTI; NTIS; GPO Dep.

Each section of this report consists of a program description; results for the quarter: and an analysis of trends over the previous two years, depending upon the availability of data. The analyst who produced each section is identified in order to facilitate the reader in following up any questions regarding the data or the analysis approach. The reader is directed to the trend subsections

for more in-depth summaries of each data section.The four major environmental topics included are air, water, meteorological processes and biological monitoring. 16 figs., 34 tabs.

**35083** (PNL-SA-19646) **Bioremediation of Hanford groundwater.** Brouns, T.M.; Anderson, D.B.; Fredrickson, J.K.; Luttrell, S.P.; Skeen, R.S.; Workman, D.J. Pacific Northwest Lab., Richland, WA (United States). Sep 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-910981-25: Environmental remediation '91 conference, Pasco, WA (United States), 8-11 Sep 1991). Order Number DE92000799. Source: OSTI; NTIS; INIS; GPO Dep.

Liquid wastes containing radioactive, hazardous, and regulated chemicals have been generated throughout the 40 years of operations at the US Department of Energy's (DOE) Hanford Site. Some of these wastes were discharged to the soil column and many of the waste components, including nitrate ($NO_3$), carbon tetrachloride ($CCl_4$), and several radionuclides, have been detected in the Hanford groundwater. Current DOE policy prohibits the disposal of contaminated liquids directly to the environment, and remediation of existing contaminated groundwaters may be required. A research and development program is underway to develop bioremediation technologies for both ex situ and in situ groundwater treatment. 16 refs., 2 figs., 3 tabs.

**35084** (RFP-4500) **Pond water analysis summary.** Bauer, J.F.; Weier, D.R. EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant. 21 Jan 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC34-90DP62349. Order Number DE91018962. Source: OSTI; NTIS; GPO Dep.

This report contains a summary of statistical analyses performed on radionuclide data for the Environmental Restoration/Clean Water Act group. While some differences in levels of radionuclides at the various sampling locations are shown, many times they are not different from the plant raw water supply. The impact of repeatedly applying standards which approximate 93rd percentiles will result in exceeding such standards on a regular basis. Reaction to exceeding such standards should take this into consideration. The observed differences in the uncertainty levels for plutonium concentrations is most likely due to the difference in the plutonium level measured. The filter socks in the current water treatment process have been ineffective in reducing the gross alpha and gross beta levels. 7 tabs.

**35085** (RLO-2227-T12-47) **Radioactive zinc ($^{65}$Zn), zinc, cadmium, and mercury in the Pacific Hake, Merluccius productus (Ayres), off the West Coast of the United States.** Naidu, J.R. Oregon State Univ., Corvallis, OR (United States). Jun 1974. 159p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AT06-76EV72012. Order Number DE92000516. Source: OSTI; NTIS; GPO Dep.

The Pacific Hake, Merluccius productus (Ayers) was used to monitor the waters off Puget Sound and the West Coast of the US for zinc(Zn), cadmium(Cd), mercury(Hg) and $^{65}$Zn. The Columbia River is not the source of Zn, Cd or Hg contamination, but is the source of $^{65}$Zn, with the concentration in the Hake reflecting the position of the Columbia River plume. Zn and Cd accumulation in the Hake were fit to the equation $Y=B_1+B_2e^{B}{}_3X$ where Y is the concentration of the element and X is the length or weight of the fish. Biological attributes were assigned to the other parameters as follows: $B_1$ is the asymptotic value for Zn or Cd at chemical maturity; $B_2$ is the location of the curve with respect to the length or weight of the fish; and $B_3$ is a constant pertaining to the rate of change of Zn or Cd. Although Zn, Cd and Hg are all Group 2B elements, only the concentrations of Zn and Cd were correlated for all locations; Hg concentrations varied as a function of location. Zn and Cd concentrations increase with fish size and approach an asymptotic value at maturity, while Hg concentrations were linear and the slope is a function of sampling location. Zn and Cd levels are regulated in the adult, while Hg continues to increase with age. It may be significant that the age distribution of fish caught commercially coincides with the maximum concentration of Zn and Cd. 195 refs., 30 figs., 10 tabs. (MHB)

**35086** (UCRL-JC-107034) **"Smart" pump and treat.** Isherwood, W. (Lawrence Livermore National Lab., CA (United States)); Rice, D. Jr.; Ziagos, J.; Nichols, E. Lawrence Livermore National Lab., CA (United States). Sep 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000498. Source: OSTI; NTIS; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) is approaching the final phase of the Superfund decision-making process for site restoration and will soon initiate full scale cleanup. Despite some well-publicized failings of the pump and treat approach, we have concluded that intelligent application of this strategy if the best choice for ground water restoration at LLNL. Our proposed approach differs sufficiently from the pump and treat methods implemented at other sites that we call it "smart" pump and treat. Smart pump and treat consists of four distinct, but interrelated, elements: three preremediation strategies and one modification to pump and treat itself. Together, these techniques are an integrated program that utilizes an understanding of crucial aspects of contaminant flow and transport to speed up the remediation of contaminated aquifers. The four elements are: (1) a spatially detailed site characterization, linked with regional hydrogeologic models; (2) directed extraction, where the extraction and recharge locations are controlled by field-determined hydrogeologic parameters; (3) field-validated modeling that the matches the complexity of the collected data; and (4) adaptive pumping, whose pattern varies with time. Together, these techniques minimize the cost and the time to reach regulatory directed cleanup goals and maximize the rate of contaminant removal. 8 refs.

**35087** (UCRL-JC-108064) **Remediation of a gasoline spill by soil vapor extraction, Lawrence Livermore National Laboratory, Livermore, CA.** Cook, G.E. (San Jose State Univ., CA (United States)); Oberdorfer, J.A.; Orloff, S.P. Lawrence Livermore National Lab., CA (United States). Sep 1991. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911185-1: Conference and exposition on petroleum hydrocarbons and organic chemicals in ground water: prevention, detection and restoration, Houston, TX (United States), 20-22 Nov 1991). Order Number DE92000488. Source: OSTI; NTIS; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) is located approximately 40 miles east of San Francisco in the southeastern portion of the Livermore Valley near Livermore, California. In 1979, an underground gasoline tank was found to be leaking. The spill occurred near Building 403 in the southeast corner of LLNL. The initial investigation confirmed the presence of gasoline contamination in both the soil and ground water. The water table is at a depth of approximately 100 feet. A pilot study on the use of soil vapor extraction in heterogeneous deposits was begun in August 1988. Fieldwork to assess the efficacy of the vapor extraction, including soil sampling and installation of three vadose zone monitoring devices, began in October 1990. 4 refs., 9 figs.

**35088** (VYH-JULK-A49) **The role and uptake of organic matter in lotic ecosystems, part 1, Environmental impacts of nitrogen loading from peat mining, areas in running waters, part 2.** Heikkinen, K.; Visuri, A. National Board of Waters and the Environment, Helsinki (Finland). 1990. 72p. (In Finnish). Order Number DE92704003. Source: OSTI; NTIS (US Sales Only).

Part 1. The literature review deals with the role and uptake of organic matter in lotic ecosystems, with special emphasis paid to the most important groups of biota in organic matter processing, i.e. benthic invertebrates and microorganisms. Part 2. Peat mining has been increasing in the 1970's especially in the drainage basins of the rivers in Osrtobothnia Drainage has resulted in increased inorganic nitrogen mobolization and transport from the peatlands in the area. The most important processes determining the rate of nitrogen transported from peat mining areas in running waters are denitrification, nitrogen binding by detritus decomposing microorganisms and primary producers, and sedimentation of particulate nitrogen and humic substances. The environmental impacts of nitrogen loading are probably greatest during minimum discharge in summer and autumn. It is anyway difficult to estimate the total effects of nitrogen loading from peat mining areas in Finnish rivers, because nitrogen cycling is not well understood.

35089 (VYH-JULK–A58) **The role of nitrogen in overfertilization of costal waters.** Puustinen, J. National Board of Waters and the Environment, Helsinki (Finland). 1990. 86p. (In Finnish). Order Number DE92703989. Source: OSTI; NTIS (US Sales Only).

The results have shown that the role of nitrogen compounds in overfertilization both in Finnish coastal waters as well as in the whole land and in other Baltic sea has not keen researched videly. The results have, however, been notable. The Finnish and Swedish results have shown that, excluding the most loaded coastal waters, the nitrogen acts as limiting nutrient for basic production in the Gulf of Finland and the middle parts of the Baltic sea during a growing season. According to the PELAG-project researching the sea area in front of Hankoniemi, the effect of the other main nutrient phosphor is notably only in the presence of nitrogen, and even then during a short period in the early summer. The key role of nitrogen in overfertilization is highlighted also in the fact that according to the results of the researches of the PELAG-project, the fertilizing effect could be achieved both with inorganic (nitrate and ammonium) and organic (urea) compounds. These observations have shown that the reduction of nitrogen emissions is the main factor in controlling of the overfertilization. E.g. removal of phosphor will not be sufficient, but the amount of nitrogen must also be reduced. Outlining of the task of overfertilization of coastal waters and nitrogen problem also requires determination of total nitrogen load of different sea areas. Most data is required of nitrogen deposition, river loads and direct waste water emissions. There is lack of information also in knowledge of nitrogen binding and denitrification. Denitrification studies of sea water have not been made in Finland. In the future it is important to repeat the researches of the basic production done at present on wider sea areas in Finland. It is also necessary to compile the data obtained from field studies with actual load development. Solving of the nitrogen problem requires also effective cooperation between the countries around the Baltic sea.

# 55 BIOMEDICAL SCIENCES, BASIC STUDIES

## 5501 Behavioral Biology

*Refer also to citation(s) 35064, 35098*

## 5502 Biochemistry

*Refer also to citation(s) 34994*

35090 (DOE/ER–0511P) **Division of Energy Biosciences annual report and summaries of FY 1991 activities.** USDOE Office of Energy Research, Washington, DC (United States). Energy Biosciences Div. Sep 1991. 114p. Sponsored by USDOE, Washington, DC (United States). Order Number DE92000518. Source: OSTI; NTIS; INIS; GPO Dep.

As a component of the Department of Energy, the Energy Biosciences (EB) program of the Office of Basic Energy Sciences supports long-term research aimed at addressing energy-related problems utilizing biological systems. There are three main components of the EB program. The first, Primary Biological Energy Conversion, concentrates on research on plant and microbial photosynthesis, but also deals with plant growth control, stress reactions, and interaction with pathogens. The second, Bioconversion of Products, concentrates on utilization of the products of primary energy conversion. Specific examples include biosynthesis of potential fuels or chemicals, biodegradation of lignocellulose into potentially useful compounds, plant/microbe symbiosis, microbial methanogenesis and fermentation. The third main component of the EB program involves providing the basic research infrastructure to support future discoveries. The emphasis here is on investigation of basic genetic mechanisms, both in novel systems and extensively studied systems such as maize; development of critical databases, techniques, and instrumentation; and support of training in areas that are important but underpopulated. Brief descriptions of currently supported research projects are provided. 186 refs., 1 tab (MHB)

35091 (DOE/ER/13968–T3) **Mechanism for the selective conjugation of ubiquitin to phytochrome: Progress report for 1990.** Vierstra, R.D. Wisconsin Univ., Madison, WI (United States). Dept. of Horticulture. [1990]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER13968. Order Number DE92000019. Source: OSTI; NTIS; GPO Dep.

The goal of this project is to understand at the molecular level how phytochrome functions and how intracellular proteins are degraded. Phytochrome is marked for degradation by covalent attachment of ubiquitin. Ubiquitin-phytochrome conjugates (UbP) were characterized with respect to formation kinetics, subcellular localization and site of ubiquitin attachment. UbP appears to be a general phenomenon during phytochrome degradation in a variety of species. UbP was isolated from oat seedlings and characterized. Residues 747-830 of phytochrome have been identified as a possible attachment site for ubiquitin. By placing the gene for etiolated phytochrome in tobacco we have created a transgenic system for over expressing phytochrome. The effects of this over expression are described, and it appears that tobacco degrades this foreign protein through formation of UbP. We have created a series of site-directed mutants of the oat phytochrome gene, and are in the process of characterizing them to determine sequence requirements for ubiquination. 8 refs., 1 fig. (MHB)

35092 (DOE/ER/14054–2) **Nuclear genes encoding plastid proteins expressed early in chloroplast development: Progress report.** Mullet, J.E. Texas A and M Univ., College Station, TX (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-89ER14054. Order Number DE91018533. Source: OSTI; NTIS; GPO Dep.

The overall objective of this grant was to characterize events which occur early in chloroplast biogenesis and to isolate nuclear genes encoding plastid proteins which are expressed during this developmental phase. In addition, the possible requirement of plastid transcription for the expression of the nuclear genes such as rbcS and cab was to be tested. The impetus for this research came from studies of chloroplast biogenesis in barley. We found that plastid DNA copy number was relatively high (120 copies/plastid vs 200 at maximal accumulation) in the meristematic region of the leaf base whereas plastid transcription activity was low in this plastid population. Later in chloroplast development transcription activity increased at least 5 fold per plastid or per template indicating that activation of plastid transcription occurred after most of the build up in plastid DNA per plastid. This suggested that activation of plastid DNA synthesis occurred early in chloroplast development and that nuclear genes involved in this activity must be regulated differently from genes such rbcS or cab which are expressed later in development. 3 refs., 7 figs.

35093 (DOE/ER/60636–T4) **Genes and gene expression: Localization, damage and control – A multilevel and interdisciplinary study: Progress report, February 1, 1991–January 31, 1992.** Ts'o, P.O.P. Johns Hopkins Univ., Baltimore, MD (United States). School of Hygiene and Public Health. Sep 1990. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER60636. Order Number DE92000706. Source: OSTI; NTIS; INIS; GPO Dep.

All projects are working toward a goal for describing the three dimensional nuclear topography in terms of relative spatial relationships among genes (specific DNA sequence). Methods are now being perfected to detect these genes, quantitatively and spatially, to perturb these genes specifically, and to measure the perturbation in order to assure specificity. We are developing methods to assay, after perturbation of the target DNA within living cells, whether or not only the target sequence are attacked while other sequences remain unharmed. We are now at the stage to do chemical gene modification or masking within living cells in a strictly sequence-specific manner. Soon, we will be able to study the function and the physical location of each gene in living cells with exquisite specificity. 25 refs., 15 figs.

35094 (DOE/ER/60676–T1) **[Molecular approaches to the study of the radiation-sensitive disease ataxia-telangiectasia (AT)]: Final technical report.** Stanford Univ., CA (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United

States). DOE Contract FG03-88ER60676. Order Number DE92000759. Source: OSTI; NTIS; INIS; GPO Dep.

The specific aims of this proposal were to isolate the wild-type AT-D gene by functional cloning, characterize this gene in detail, and overexpress the cloned gene and explore the structure and function of its protein product. The sequence of the gene will be compared to that of alleles from complementation groups A, C, D and E in order to determine the molecular basis for mutational inactivation of the AT gene and determine definitively whether more than one wild-type gene exists in the human genome. We have isolated a cell line consisting of a single human chromosome 18 on a mouse background. It originally appeared that the AT-D gene was localized to this chromosome, but additional studies revealed the presence of cytologically undetectable human chromosome 11. Further study now indicated that the human AT-D gene is located on human chromosome 11 in the region 11q22-23. 4 refs. (MHB)

**35095** (DOE/ER/61139–1) **Chromosome region-specific libraries for human genome analysis: Progress report, March 1, 1991–August 31, 1991.** Kao, Fa-Ten. Eleanor Roosevelt Inst. for Cancer Research, Denver, CO (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-91ER61139. Order Number DE92001741. Source: OSTI; NTIS; GPO Dep.

We have made important progress since the beginning of the current grant year. We have further developed the microdissection and PCR- assisted microcloning techniques using the linker-adaptor method. We have critically evaluated the microdissection libraries constructed by this microtechnology and proved that they are of high quality. We further demonstrated that these microdissection clones are useful in identifying corresponding YAC clones for a thousand-fold expansion of the genomic coverage and for contig construction. We are also improving the technique of cloning the dissected fragments in test tube by the TDT method. We are applying both of these PCR cloning technique to human chromosomes 2 and 5 to construct region-specific libraries for physical mapping purposes of LLNL and LANL. Finally, we are exploring efficient procedures to use unique sequence microclones to isolate cDNA clones from defined chromosomal regions as valuable resources for identifying expressed gene sequences in the human genome. We believe that we are making important progress under the auspices of this DOE human genome program grant and we will continue to make significant contributions in the coming year. 4 refs., 4 figs.

**35096** (LA-UR–91-3050) **Biosynthesis of metal-binding polypeptides and their precursors in response to cadmium in Datura innoxia.** Jackson, P.J.; Delhaize, E.; Kuske, C.R. Los Alamos National Lab., NM (United States). [1991]. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Grant RPI5004666/F482. (CONF-9109284–1: 4. international symposium on genetic aspects of plant mineral nutrition, Canberra (Australia), 30 Sep - 4 oct 1991). Order Number DE92000194. Source: OSTI; NTIS; GPO Dep.

Metal-tolerant Datura innoxia cells synthesize large amounts of a class of metal-binding polypeptides, poly($\gamma$-glutamylcysteinyl) glycines [$(\gamma\text{-EC})_n$G, n=2-5], when exposed to Cd. These polypeptides have a high affinity for Cd (2) and certain other metal ions and are thought to play a role in metal tolerance in higher plants. $(\gamma\text{-EC})_n$G is biosynthetically derived from glutathione. Therefore, the response of Datura cells to Cd must include an increase in production of glutathione and its precursors, since cells rapidly accumulate very high concentrations of these metal-binding polypeptides. The biosynthesis of $(\gamma\text{-EC})_n$Gs, glutathione, and cysteine in response to Cd exposure is described. The physiological significance of the synthesis of these polypeptides and their precursors and its relevance to Cd tolerance and metal homeostasis are discussed. 34 refs., 6 figs., 1 tab.

**35097** (ORNL/TM–11924) **GAP: A computer program for gene assembly.** Eisnstein, J.R.; Uberbacher, E.C.; Guan, X.; Mural, R.J.; Mann, R.C. Oak Ridge National Lab., TN (United States). Sep 1991. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000282. Source: OSTI; NTIS; GPO Dep.

A computer program, GAP (Gene Assembly Program), has been written to assemble and score hypothetical genes, given a DNA sequence containing the gene, and the outputs of several other programs which analyze the sequence. These programs include the codign-recognition and splice-junction-recognition modules developed in this laboratory. GAP is a prototype of a planned system in which it will be integrated with an expert system and rule base. Initial tests of GAP have been carried out with four sequences, the exons of which have been determined by biochemcial methods. The highest-scoring hypothetical genes for each of the four sequences had percent correct splice junctions ranging from 50 to 100% (average 81%) and percent correct bases ranging from 92 to 100% (average 96%). 9 refs., 1 tab.

## 5503 Cytology

*Refer also to citation(s) 35092, 35093, 35142*

## 5504 Genetics

*Refer also to citation(s) 35064, 35090, 35092, 35093, 35094, 35095, 35097*

**35098** (EGG–10617-2094) **Conservation of the endangered San Joaquin kit fox at Camp Roberts Army National Guard Training Site, California.** EG and G Energy Measurements, Inc., Las Vegas, NV (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-88NV10617. (CONF-9108166–1: National Military Fish and Wildlife Association (NMFWA) meeting, Colorado Springs, CO (United States), 16 Aug 1991). Order Number DE91018987. Source: OSTI; NTIS; GPO Dep.

Camp Roberts is a California Army National Guard Training Site located in central California. The San Joaquin kit fox, an endangered subspecies of kit fox, has been known to occur at Camp Roberts since 1960. The population of foxes began to increase in the early 1970's when use of rodenticides decreased. In 1987 the California Army National Guard contracted EG&G Energy Measurements to conduct a 3-year study to assess the effects of Camp Roberts activities on the kit fox population. A discussion of the current Conservation Program is provided. EG&G will prepare a revised Biological Assessment in late 1991. It appears that activities which occur on Camp Roberts, if efficiently regulated, will not have any significant effect on the local population of kit foxes. (MHB)

## 5505 Metabolism

*Refer also to citation(s) 34764*

## 5506 Medicine

*Refer also to citation(s) 33808, 33821, 34763, 34775*

**35099** (DOE/ER/60519–T3) **[New imaging systems in nuclear medicine]: Technical progress report.** Massachusetts General Hospital, Boston, MA (United States). Physics Research Lab. [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER60519. Order Number DE92000786. Source: OSTI; NTIS; INIS; GPO Dep.

We continue to use and maintain PCR-I, the single-slice high-resolution high-sensitivity positron emission tomograph, while development proceeds on PCR-II, a three-dimensional PET system. A two-dimensional BGO scintillation detector has been designed and we are nearing completion of the detector, including the light guide, crystals and phototube assembly, and the gantry electronics. We are currently exploring techniques for a very high resolution (sub-mm) PET imaging system. We are using the current PCR-I system to assess changes in presynaptic dopamine receptors and glucose utilization in current biological models of Huntington's disease. Our preliminary studies support the use of the primate (Cynomolgus monkey) model of Huntington's disease to monitor in vivo functional changes. We are planning to extend this study to examine the MPTP model of Parkinson disease, and to assess the therapeutic value of $D_1$ dopamine receptor agonists for treatment of MPTP-induced neurological defects. 13 refs., 5 figs. (MHB)

**35100** (DOE/ER/60874–2) **Design of an accelerator-based epithermal neutron beam for boron neutron capture therapy.** Yanch, J.C. (Massachusetts Inst. of Tech., Cambridge, MA (United States)); Zhou, X.L.; Brownell, G.L.; Shefer, R.E.; Klinkowstein, R.E. Massachusetts Inst. of Tech., Cambridge, MA (United States). [1990]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER60874. (CONF-901226–7: 4. international symposium on neutron capture therapy, Sydney (Australia), 3-7 Dec 1990). Order Number DE91018873. Source: OSTI; NTIS; INIS; GPO Dep.

Recent interest in the production of epithermal neutrons for use in boron neutron capture therapy (BNCT) has prompted an investigation into the feasibility of generating such neutrons with a tandem cascade accelerator. Accelerator-produced neutrons in the range of roughly 200–800 keV are generated in a lithium compound target via the $^{7}Li(p,n)^{7}Be$ nuclear reaction in a tandem cascade accelerator currently under development by Science Research Laboratory, Somerville, MA. Details of the design of the proton accelerator and operating characteristics will be too energetic for use in neutron capture therapy, a detailed dosimetric study was undertaken to determine the energy, or range of energies most suitable for NCT. This study was carried out using three-dimensional Monte Carlo transport calculations; results are discussed briefly here. Once the most suitable range of energies for BNCT was determined, it was then possible to design an appropriate moderator assembly to shift the energy of the neutrons down to the therapeutically useful levels. Such an assembly has been designed with the aid of computer simulation; calculations of treatment parameters indicate that the accelerator neutron beam can provide dose rates and advantage depths comparable to currently available reactor beams for neutron capture therapy. 10 refs., 5 figs.

**35101** (INIS-mf–12968, pp. 7-9) **The role of accelerated RIA diagnosis within GIFT program.** Seifert, B. (Medizinische Akademie, Magdeburg (Germany, F.R.)); Kapitza, W.; Nickel, I.; Denck, D.; Karsten, U. Palackeho Univ., Olomouc (Czechoslovakia). Lekarska Fakulta. 1991. 92p. (In German). (CONF-9006377–: RIA - 6. international symposium on the use of immuno- and radioimmunoassays in obstetrics and gynecology, Olomouc (Czechoslovakia), 21-22 Jun 1990). In *RIA - the use of immuno- and radioimmunoassays in obstetrics and gynecology: Proceedings of the 6th international symposium.* Order Number DE92601288. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. ESTRADIOL/radioimmunoassay; PROGESTERONE/radioimmunoassay; ESTRADIOL; RADIOIMMUNOASSAY; FERTILIZATION; PREGNANCY; PROGESTERONE

**35102** (INIS-mf–12968, pp. 10-11) **Comparison of SYNELISA and RIA assays in determination of pituitary gonadotropins.** Kudrnova, J. (Fakultni Nemocnice Bulovka, Prague (Czechoslovakia)); Stern, P.; Bartak, A. Palackeho Univ., Olomouc (Czechoslovakia). Lekarska Fakulta. 1991. 92p. (CONF-9006377–: RIA - 6. international symposium on the use of immuno- and radioimmunoassays in obstetrics and gynecology, Olomouc (Czechoslovakia), 21-22 Jun 1990). In *RIA - the use of immuno- and radioimmunoassays in obstetrics and gynecology: Proceedings of the 6th international symposium.* Order Number DE92601288. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. GONADOTROPINS/enzyme immunoassay; GONADOTROPINS/radioimmunoassay; COMPARATIVE EVALUATIONS; FSH; GONADOTROPINS; RADIOIMMUNOASSAY; GYNECOLOGY; LH; LTH

**35103** (INIS-mf–12968, pp. 81-84) **The RIA of progesterone in saliva of pregnant women.** Fingerova, H. (Palackeho Univ., Olomouc (Czechoslovakia). Lekarska Fakulta); Janouskova, M.; Cerna, H. Palackeho Univ., Olomouc (Czechoslovakia). Lekarska Fakulta. 1991. 92p. (CONF-9006377–: RIA - 6. international symposium on the use of immuno- and radioimmunoassays in obstetrics and gynecology, Olomouc (Czechoslovakia), 21-22 Jun 1990). In *RIA - the use of immuno- and radioimmunoassays in obstetrics and gynecology: Proceedings of the 6th international symposium.* Order Number DE92601288. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. PROGESTERONE/radioimmunoassay; PROGESTERONE/saliva; BLOOD SERUM; GYNECOLOGY; PREGNANCY; PROGESTERONE; RADIOIMMUNOASSAY; SALIVA; WOMEN

**35104** (INIS-mf–12968, pp. 85-87) **False MS-AFP results in fetal NTD screening in pregnancy.** Tomasek, J. (Regional Hospital, Usti nad Labem (Czechoslovakia)); Ondrej, J.; Mareckova, O.; Plzak, V.; Kofer, J. Palackeho Univ., Olomouc (Czechoslovakia). Lekarska Fakulta. 1991. 92p. (CONF-9006377–: RIA - 6. international symposium on the use of immuno- and radioimmunoassays in obstetrics and gynecology, Olomouc (Czechoslovakia), 21-22 Jun 1990). In *RIA - the use of immuno- and radioimmunoassays in obstetrics and gynecology: Proceedings of the 6th international symposium.* Order Number DE92601288. Source: OSTI; NTIS (US Sales Only); INIS.

Published in summary form only. CONGENITAL MALFORMATIONS/radioimmunoassay; BLOOD SERUM; RADIOIMMUNOASSAY; FETUSES; PREGNANCY; ULTRASONOGRAPHY

**35105** (KURRI-TR–342) **Workshop on the accelerator for particle therapy.** Inoue, M.; Ujeno, Y. (eds.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Feb 1991. 80p. (In Japanese). (CONF-9008222–: Workshop on the accelerator for particle therapy, Kumatori (Japan), 22-23 Aug 1990). Order Number DE92704294. Source: OSTI; NTIS (US Sales Only); INIS.

A two-day workshop on the accelerator for particle therapy was held on August 22-23, 1990, with the aim of mutual understanding of medical accelerators among investigators. The state-of-the-art facilities in Japan and medical proton accelerators in Japan and other countries were introduced. This is a compilation of papers presented at the workshop: (1) particle radiotherapy at the National Institute of Radiological Sciences (NIRS); (2) proton therapy; (3) treatment planning, especially for photon and electron therapies; (4) heavy ion synchrotron project at the NIRS; (5) medical proton accelerator project of Tsukuba University and recent status of Loma Linda University Medical Center Proton Beam Facility; (6) inspection report on the Loma Linda University Medical Center Proton Beam Facility; (7) accelerator project of Kyoto University; (8) actual conditions of the 7 MeV proton linear accelerator; (9) design study of superconducting compact cyclotron prototype model; (10) medical superconducting prototype cyclotron; (11) RCNP cyclotron cascade project; (12) beam extraction from synchrotron; (13) radiation safety design in high energy particle accelerator facilities. (N.K.).

## 5507 Microbiology

*Refer also to citation(s) 33570, 33584, 33598, 33649, 33657, 33658, 33660, 33661, 33777, 33852, 35073, 35090*

## 5508 Morphology

**35106** (PNL-SA–19901) **Microstructures and mechanical behavior of mollusk shells.** Laraia, V.J. (Case Western Reserve Univ., Cleveland, OH (United States). Dept. of Materials Science and Engineering); Heuer, A.H. Pacific Northwest Lab., Richland, WA (United States). Mar 1991. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9009185–1: 11. Riso international symposium on metallurgy and materials science: structural ceramics processing microstructure and properties, Riso (Denmark), 3-7 Sep 1990). Order Number DE91018824. Source: OSTI; NTIS; GPO Dep.

Biological hard tissues are load-bearing structural materials, composed of a mineral (ceramic) component and an organic (protein) component. The microstructures of three composite designs commonly found in mollusk shells, the nacreous, foliated, and crossed-lamellar structures are discussed. Although all of these can be viewed as laminar composites, differences exist in the morphology, crystal structure, defect microstructure, and spatial organization of the mineral, $CaCo_3$. Electron microscopy investigations of these materials reveal a variety of crystallographic defects, the details of which have been used to refine existing models for biomineralization in these tissues. Flexural strengths in four-point

bending are on the order of 100 Mpa. Examples of "graceful failure", i.e. stable crack growth in bulk samples, in the crossed-lamellar and foliated structures are reported. Fractography of such specimens reveals that a number of familiar toughening mechanisms operate together to produce this desirable structural flaw tolerance. Even more unusual is the fact that mollusk shells are harder than the native minerals from which they are made! The damage zones and the anisotropy of hardness suggest an explanation for the anomalous hardness based on microstructural design rather than on intrinsic hardening of the mineral phase. 27 refs., 15 figs., 2 tabs.

### 5509 Pathology

*Refer also to citation(s) 33853, 35094*

### 5510 Physiological Systems

*Refer also to citation(s) 35142*

### 5520 Public Health

*Refer also to citation(s) 35082*

### 5530 Agriculture and Food Technology

*Refer also to citation(s) 33833, 33852, 34400, 35090*

**35107** (AECL–9553) **Post-irradiation chemical analyses of poultry: A review.** Singh, H. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1988. 63p. Order Number DE91642162. Source: OSTI; NTIS (US Sales Only); INIS.

Salmonella contamination of chicken is a major public health concern. While heat pasteurization and chlorine treatment for Salmonella have shortcomings, low doses of gamma radiation are very effective in controlling Salmonella. The organoleptic shelf life of fresh chicken at 1 to 4 degrees Celsius (6 to 10 days) is extended by a factor of $\sim 2$ by a dose of 2.5 kGy and does not increase further with higher doses up to $\sim 8$ kGy. The reason for the lack of greater organoleptic shelf life is the continuing degradative changes in meat due to enzymatic activity. The product obtained with doses around 2.5 kGy is very good, and is acceptable up to doses of $\sim 8$ kGy. Irradiation at doses higher than 2.5 kGy results in some odor that disappears on storage at 1 to 4 degrees Celsius, and on roasting of the meat. The odor is due to the production of some of the small molecular weight volatile compounds, which are also produced by free-radical mediated autoxidation, thermal treatment, and enzymatic and microbial reactions with the meat components. Low-dose irradiation shows insignificant changes in the physical attributes like water-holding capacity, changes in proteins, amino acids, fats and rancidity indices. Review of the feeding studies with radiation-sterilized chicken meat ($\geq$ 30 kGy, the Raltech study) indicated that the irradiated meat was wholesome and safe. It is therefore, reasonable to assume that the low-dose ($\leq$ 8 kGy) irradiated chicken would also be safe. Also the two Federation of American Societies for Experimental Biology (FASEB) committees, which reviewed the over 100 identified volatile compounds produced in $\mu$g/kg (ppb) quantities, concluded that there were no ground for suspecting these products of being a hazard to the consumer.

**35108** (NIRS-RSD–93) **Radioactivity survey data in Japan, part 2. Dietary materials.** National Inst. of Radiological Sciences, Chiba (Japan). Apr 1991. 32p. Order Number DE92704015. Source: OSTI; NTIS (US Sales Only); INIS.

The publication is aimed at providing radioactivity survey data in environmental and dietary materials in Japan. Part 2 gives dietary materials, consisting of total diet, milk, vegetables, sea fish, freshwater fish, shellfish, and seaweeds. Samples were collected from 42 sampling locations during the period between May 1989 and June 1990, and were sent to the Japan Chemical Analysis Center for radiochemical analysis. Strontium-90 and cesium-137 in these dietary materials are tabulated. The maximum concentrations of strontium-90 and cesium-137 were as follows: 0.16+-0.017 Bq/pcenter dotd and 0.20+-0.014 Bq/pcenter dotd, respectively, for total diet; 0.10+-0.011 Bq/l and 1.0+-0.03 Bq/l for milk (producing districts); 0.08+-0.010 Bq/l and 0.14+-0.010 Bq/l for milk (consuming districts); 0.55+-0.026 Bq/Kgwet and 1.2+-0.03 Bq/Kgwet for vegetables (producing districts); 0.34+-0.023 Bq/Kgwet and 0.05+-0.009 Bq/Kgwet for vegetables (consuming districts); 0.02+-0.011 Bq/Kgwet and 0.25+-0.026 Bq/Kgwet for sea fish; 5.5+-0.09 Bq/Kgwet and 0.082+-0.033 Bq/Kgwet for freshwater fish; 0.01+-0.010 Bq/Kgwet and 0.06+-0.009 Bq/Kgwet for shellfish; and 0.03 +-0.009 Bq/Kgwet and 0.03+-0.006 Bq/Kgwet for seaweeds. Yearly changes in the concentrations of both strontium-90 and cesium-137 from 1986 through 1990 are given in figures. (J.P.N.).

## 56 BIOMEDICAL SCIENCES, APPLIED STUDIES

### 5601 Radiation Effects

*Refer also to citation(s) 34129, 34775, 35133, 35134, 35135, 35314, 35321*

**35109** (ANL/CP–74386) **History of the determination of radium in man since 1915.** Rundo, J. Argonne National Lab., IL (United States). [1991]. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-911011–1: International workshop on radium, uranium, thorium and related nuclides in industry and medicine: history and current use, Badgastein (Austria), 1-3 Oct 1991). Order Number DE92000355. Source: OSTI; NTIS; GPO Dep.

The determination of radium in man can be traced back to experiments in 1915 when volunteers were injected with, or ingested, solutions of a radium salt, and the excreta were analyzed for radium. However, the first direct demonstrations of the presence of radium in vivo years after exposure were reported in 1925 by Martland et al. A few years later, Schlundt et al. repeated Martland's types of measurements with a Wulf-Hess electroscope, in an attempt to be quantitative. Data on the excretion rate of radium were published by Schlundt and Failla in 1931. The results of an investigation by the US Public Health Service of the health aspects of radium dial painting were published in three papers in 1933. In the second of these, Ives et al. reported results for 40 subjects who showed gamma-ray results of 1 $\mu$g radium (i.e., retained radon) or more. There was a major improvement in sensitivity in 1937 when Evans described the use of a Geiger-Mueller detector and the metre-arc geometry. Ten years later, Hess and McNiff published details of an ionization chamber method that did permit such levels to be determined. In the early 1950s, three groups described the first equipments for the assay of radioactivity in the human body that could detect the radiation from the naturally radioactive potassium content. In 1955, the introduction by Marinelli et al. of the sodium iodide crystal as gamma-ray detector revolutionized the assay of radium (and all other gamma-ray emitters) in vivo. These factors have all contributed to a steady decrease in the lower limit of detection of radium in man that was roughly exponential from 1929 to the mid-1950s with a half-period of a little over 3 years. 36 refs., 4 figs., 5 tabs.

**35110** (BfS-ISH–149/90) **Blood amylase - a biochemical radiation indicator?.** Hofmann, R.; Hendriks, W.; Schreiber, G.A.; Boegl, K.W. Bundesamt fuer Strahlenschutz, Neuherberg (Germany). Inst. fuer Strahlenhygiene. Dec 1990. 48p. Order Number DE92714366. Source: OSTI; NTIS (US Sales Only); INIS.

This study describes the suitability of the biological radiation indicator 'amylase in human blood serum' to identify, if previous irradiation has occurred. After 'in vivo' exposure, of the human body with organ doses > 0,5 Gy, high activities of the enzyme are found in serum. The important results of examinations from different work groups and from own experiments were summarized in tabular form and evaluated from the statistic point of view. The results show that in more than 90% of all cases, the amylase system is suitable to identify exposure beyond 0,5 to 1 Gy, approximately. However, this is only possible if the salivary glands were also

exposed and blood samples are taken about 18 hours after exposure. For the differentiation between induced increase of amylase from disease and radiation induced increase, it is recommended to carry out the isoamylase test, which makes it possible to distinguish between the individual enzymes. The assessment of the total amylase is appropriate to detect, with a range of significance of P = 0,05 that radiation exposure has occurred. The increase of activity is dose dependent when the salivary glands lie in the radiation field, however, the variations of activity are very high. Therefore the radiation dose cannot be considered. Only in cases where a very high radiation induced increase of activity is observed, a rough estimation of dose at the parotid glands can be made. (orig./MG).

**35111** (BNL–46568) **When is a dose not a dose?.** Bond, V.P. Brookhaven National Lab., Upton, NY (United States). [1991]. 34p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9104298–1: National Council on Radiation Protection and Measurements (NCRP) annual meeting, Washington, DC (United States), 2-3 Apr 1991). Order Number DE92000132. Source: OSTI; NTIS; INIS; GPO Dep.

Although an enormous amount of progress has been made in the fields of radiation protection and risk assessment, a number of significant problems remain. The one problem which transcends all the rest, and which has been subject to considerable misunderstanding, involves what has come to be known as the 'linear non-threshold hypothesis', or 'linear hypothesis'. Particularly troublesome has been the interpretation that any amount of radiation can cause an increase in the excess incidence of cancer. The linear hypothesis has dominated radiation protection philosophy for more than three decades, with enormous financial, societal and political impacts and has engendered an almost morbid fear of low-level exposure to ionizing radiation in large segments of the population. This document presents a different interpretation of the linear hypothesis. The basis for this view lies in the evolution of dose-response functions, particularly with respect to their use initially in the context of early acute effects, and then for the late effects, carcinogenesis and mutagenesis. 11 refs., 4 figs. (MHB)

**35112** (CONF-910137–, pp. 182-195) **Minimizing exposure in nuclear medicine through optimum use of shielding devices.** Rutherford, B.L. (Pennsylvania State Univ., Hershey, PA (USA)); King, S.H.; Erdman, M.C.; Miller, K.L. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Exposure to radiation from nuclear medicine nuclides can be minimized through the use of various shielding devices. This paper reviews the dose reductions achieved through use of various syringe shields, lead aprons, leaded gloves, and several types of eyeglass lenses for $^{67}Ga$, $^{99m}Tc$, $^{131}I$ and $^{201}Tl$. The authors have found that combination of devices can best provide for minimizing doses.

**35113** (CONF-910137–, pp. 213) **Radiation biology of the embryo/fetus.** Roessler, G.S. (Univ. of Florida, Gainesville (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The effects of ionizing radiation exposures on the embryo and fetus must be reviewed and updated periodically so that the exposures of the pregnant or potentially pregnant female can be evaluated. Experimental data on the effect of radiation on the developing embryo and fetus show that the unborn child is more radiosensitive than an adult. Until recently most of this data came from studies obtained with the mouse or rat. These animals were chosen for study because they reproduce in quantity with a relatively short gestation period. Animal irradiation in utero produced lethal effects even at relatively small doses before or immediately after implantation of the embryo into the uterine wall. Malformations were seen following exposures during organogenesis and growth disturbances without malformations were observed after exposures which took place during the latter part of pregnancy. New data from studies of persons exposed in utero during the atomic bombings of Hiroshima and Nagasaki show an increased incidence of microcephaly and mental retardation. The critical period for exposure was from 8 to 15 weeks of intrauteine life. During this time period a linear relationship was found between the incidence of mental retardation and absorbed dose. This human data can be used to develop risk coefficients for exposures during various stages of development. Some studies show an increased incidence of childhood leukemia and other malignancies in children who were x-rayed in utero. This increased sensitivity of the embryo and fetus to radiation carcinogenesis has generally not been shown in animal studies nor in the studies of the survivors of the bombings at Hiroshima and Nagasaki.

**35114** (CONF-910137–, pp. 232-241) **Dealing of embryo/fetal exposures in a medical setting.** Miller, K.L. (Pennsylvania State Univ., Hershey (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The medical environment presents two uniquely different situations involving potential radiation exposure to the embryo or fetus. On the one hand we have the potential for radiation exposure to the embryo of fetus of the occupationally exposed employee where the recommendations are well defined. On the other hand we have the pregnant or potentially pregnant patient requiring diagnostic radiological examinations or therapeutic procedures where the recommendations are not as well defined. This paper provides an overview of both situations, a discussion of potential exposures and a review of methods for estimating fetal doses when the exposed individual is the patient.

**35115** (INIS-mf–14008, pp. 15-18) **Hematopoietic stem cells - sensitive target cells for environmental carcinogens.** Peterson, H.P. (Forschungszentrum Juelich GmbH (Germany, F.R.)); Feinendegen, L.E. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

Stem cells of the hemopoietic system in the bone marrow are important target cells for carcinogenic effects of the environment, because it is their huge proliferation ability that enables the potential spreading of transformed (blood) cells all over the body: Normally about 250 billions of red cells and about 125 billions of white cells have to be produced daily by an adult human; in case of blood loss or infection this cell production can be increased enormously. Hemopoietic Stem Cells (HSC) react in a very sensitive manner to environmental stimuli as can be shown on examples with radiation, chemical agents or magnetic field exposure. The effect of these environmental factors was seen as a change in the number of colonies on spleens of conditioned mice after bone marrow transplantation. In order to look for a change in the quality of HSC we have developped an assay, by which early and late effects of potential carcinogenic factors in the hemopoietic system can be demonstrated. It is to be discussed, whether these late effects are involved with a special mechanism for the induction of cancer, expecially leukemia. (orig.).

**35116** (INIS-mf–14008, pp. 49-51) **Radiobiological significance of environmental radioactivity.** Hagen, U. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany, F.R.)). Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

The contribution of various radiation sources to the environmental radioactivity will be described, the natural radiation as well as

the anthropogenic ones. The cancerogenic effect of these radiation sources may be evaluated by a multisteg analysis as the maligne transformation in cell cultures, by experiments with animals and by epidemiological studies on populations with a radiation burden. (orig.).

**35117** (INIS-mf–14008, pp. 52-55) **The problem of risk assessment of environmental exposure to ionizing radiation.** Schmitz, T. (Forschungszentrum Juelich GmbH (Germany, F.R.)); Booz, J.; Feinendegen, L.E. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

Only a complete description of biological systems allows the assessment of health risks due to ionizing radiations at environmental levels (Feinendegen, 1990). The smallest functional entity in biological systems appears to be the living cell. At first the risk of a cell to a radiation stimulus and the severity of this stimulus has to be ascertained. These are physical parameters, which depend on the type of radiation and the dose. Furtheron, the kind and probability of the cell reaction to radiation stimuli has to be determined. This is a biological parameter, which depends on the condition of the cell at the time of exposure. This parameter is not invariant, since defence and repair mechanisms are available to the cell. Only if the response of cells is known as a function of radiation quality and its condition at the time of the exposure, the assessment of concequences for a cell system (organ or organism) may be attempted. Due to the variability of cell responses to ionising radiation events, a linear relation between dose and effect may not be generally valid at the system level. (orig.).

**35118** (INIS-mf–14008, pp. 56-59) **Environmental radioactivity and cancer: Radon as an example.** Paretzke, H.G. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany, F.R.)); Jacobi, W. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

The natural radiation exposure of man by radon and its daughter products represents the largest contribution to the average annual radiation exposure of the public (nearly one to a few Millisievert a year). The critical bronchial region of the lung, therefore, experiences an average natural exposure ten times higher than other tissues and organs outside the lung. The resulting mean lifetime exposure of the public is lower only by a factor of 4 than the value where among miners a statistically significant increase of the lung cancer rate was found. Under the present assumptions on the dose-effect relationships for radon and its decay products, up to 10 percent of the annually nearly 25,000 lethal lung cancer cases in the Federal Republic of Germany might be due to the inhalation of these radionuclides. A number of simple protection measures exist to reduce this radiation risk which is for the world population each single year larger by about two orders of magnitude than the 50 year cumulated radiation risk from the reactor accident in Chernobyl. (orig.).

**35119** (INIS-mf–14008, pp. 60-63) **Experiments on carcinogenesis of thorotrast and quartz.** Wesch, H. (Deutsches Krebsforschungszentrum, Heidelberg (Germany, F.R.)); Spiethoff, A.; Wegener, K.; Klimisch, H.J. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

A long-term animal study was designed to investigate the effect of Thorotrast on the lung in combination with an additional, chronical insult. For that reason rats were treated with Thorotrast and exposed to different concentrations of crystalline silica (quartz). The results demonstrate that the combined action of Thorotrast and quartz results in an increase of the lung tumor development. The carcinogenic effect of each agent and their synergistic interaction are discussed. (orig./MG).

**35120** (KURRI-TR–350) **Proceedings of the symposium on 'radiation research in life science': Brain damage and heritable damage.** Ikushima, Takaji (ed.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Jun 1991. 135p. (In Japanese). (CONF-9102139–: Symposium on 'radiation research in life science', Kumatori (Japan), 26-28 Feb 1991). Order Number DE92713959. Source: OSTI; NTIS (US Sales Only); INIS.

This issue is the collection of the papers presented at the title meeting on brain damage and heritable damage. The 12 of the presented papers are indexed individually. (J.P.N.).

**35121** (NIRS-M–78, pp. 83-90) **Radioactive aerosol exposure system of NIRS.** Yamada, Yuji (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). Mar 1991. (In Japanese). (CONF-891290–: 21. annual NIRS symposium on inhalation of airborne particles and induction mechanisms, Chiba (Japan), 7-9 Dec 1989). In *Inhalation of airborne particles and mechanisms for induction of biological effects.* 271p. Order Number DE91508518. Source: OSTI; NTIS (US Sales Only); INIS.

Radioactive aerosol exposure system for small rodents was developed, and its basic characteristics were investigated from the viewpoint of aerosol engineering on inhalation toxicology. The system has three nebulizers which liquid is feeded with syringe pump. Aerosol concentration within the exposure chamber is controlled by changing the speed of liquid feeding, and it is automatically maintained by switching one of nebulizers on the base of aerosol monitoring data from a high sensitivity photometer. Correspondingly, the air pressure and the air flow rate are controlled for keeping constant exposure. For acute exposure, animals are hold in specially designed containers, and only their noses are exposed. During exposure, the container also works as whole-body plethysmograph box and is enable us to measure animal's respiratory function. (author).

**35122** (NIRS-M–78, pp. 115-123) **Factors affecting on the particle deposition in the respiratory tract.** Kubota, Yoshihisa (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). Mar 1991. (In Japanese). (CONF-891290–: 21. annual NIRS symposium on inhalation of airborne particles and induction mechanisms, Chiba (Japan), 7-9 Dec 1989). In *Inhalation of airborne particles and mechanisms for induction of biological effects.* 271p. Order Number DE91508518. Source: OSTI; NTIS (US Sales Only); INIS.

The deposition pattern of inhaled particles in the respiratory tracts is affected by anatomical structure of the respiratory tracts and respiratory pattern of animals, which are modified by many factors as animal species, physiological and psychological conditions, age, sex, smoking drug, lung diseases, etc. In human, studies have been focused on the initial lung deposition of particles and have made it clear that the respiratory pattern, gender, and diseases may have influence on the deposition pattern. On the other hand, there was little knowledge on the initial lung deposition of particles in laboratory animals. Recently, Raabe et al. have reported the initial lung deposition of $^{169}$Yb-aluminosilicate particles in mice, rats, hamsters, guinea pigs and rabbits. The authors have also investigated the lung deposition of latex particles with different sizes and $^{198}$Au-colloid in rats whose respiratory volumes during the inhalation were monitored by body plethysmography. These experiments indicated that the deposition of inhaled particles in distal lung e.g. small bronchiolar and alveolar region, was much lower in laboratory animals than that of human. This species difference may be due to smaller diameter of respiratory tract and/or shallower breathing and higher respiratory rate of laboratory animals. The experimental animals in which respiratory diseases were induced artificially have been used to investigate the modification factors on the deposition pattern of inhaled particles. As respiratory diseases, emphysema was induced in rats, hamsters, beagle dogs in some laboratories and pulmonary delayed type hypersensitivity reaction in rats was in

our laboratory. The initial lung deposition of particles in these animals was consistently decreased in comparison with normals, regardless of the animal species and the type of disease. (author).

**35123** (NIRS-M–78, pp. 133-141) **Partial deposition distribution of unattached atom to tracheobronchial region.** Shimo, Michikuni (Nagoya Univ. (Japan)); Ohashi, Atsuto. National Inst. of Radiological Sciences, Chiba (Japan). Mar 1991. (In Japanese). (CONF-891290–: 21. annual NIRS symposium on inhalation of airborne particles and induction mechanisms, Chiba (Japan), 7-9 Dec 1989). In *Inhalation of airborne particles and mechanisms for induction of biological effects.* 271p. Order Number DE91508518. Source: OSTI; NTIS (US Sales Only); INIS.

To evaluate precisely the human lung dose, it is important to know the deposition fraction and positions on the surface of trachea and bronchial for unattached atoms. In this paper, historical review on deposition experiments and calculation were summarized. In addition the author's result was introduced for deposition experiment on unattached radon daughter atoms to tracheobronchial using a tree model based on Weibel's lung model. The results were as follows; (1) 'hot spots' which were deposited several times than around area were especially observed in inner side of generation. (2) Deposition fraction at generation 0 was 2.2≈2.7 times value calculated from the Gormley and Kennedy formula whereas values at other generations agreed with calculated ones. (author).

**35124** (NIRS-M–78, pp. 142-149) **The range distribution of α-particles in deep lung.** Nakano, Takashi (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). Mar 1991. (In Japanese). (CONF-891290–: 21. annual NIRS symposium on inhalation of airborne particles and induction mechanisms, Chiba (Japan), 7-9 Dec 1989). In *Inhalation of airborne particles and mechanisms for induction of biological effects.* 271p. Order Number DE91508518. Source: OSTI; NTIS (US Sales Only); INIS.

We calculated the range distribution of α-particles in deep lung by using digitalized graphic data made from a real tissue section. We also used a mathematically made honeycomb lattice model to compare the results between these two different models. The initial α-particle energy was chosen in the range given by the long lived α-emitters that might be potentially inhaled by human. Energy loss of α-particles was calculated from a semi-empirical formula proposed by Benton and Henke (Nucl. Instrum. Methods 67 (1969) 87). Self-absorption effect of source particle was also evaluated, in which a spherical source was assumed. The average ranges increased proportionately with the initial α-particle energy for both models. The distribution of the ranges for the honeycomb lattice model, however, should several distinct peaks which reflected the regular structure of the honeycomb lattice. For the real lattice, on the other hand, the ranges distributed broadly with a gentle-sloping hill. These results suggested the validity of the present range calculation using a real tissue section. The self-absorption effect on the range can be neglected for such a small source particle that could pass into deep lung and deposit there. (author).

**35125** (NIRS-M–78, pp. 150-157) **Particle size dependence of hit probability for lung cells.** Ishigure, Nobuhito (National Inst. of Radiological Sciences, Chiba (Japan)). National Inst. of Radiological Sciences, Chiba (Japan). Mar 1991. (In Japanese). (CONF-891290–: 21. annual NIRS symposium on inhalation of airborne particles and induction mechanisms, Chiba (Japan), 7-9 Dec 1989). In *Inhalation of airborne particles and mechanisms for induction of biological effects.* 271p. Order Number DE91508518. Source: OSTI; NTIS (US Sales Only); INIS.

The macroscopic quantity 'absorbed dose' loses its validity to interpret the radiation-induced biological effects in the lung inhaled with particulate α-emitters like transuranic elements, because the doses to individual cells differ more widely than the range of doses over which the dose-response relationship can be regarded as linear. We intend to make up a three-dimensional model of parenchymal lung using a stack of actual histological sections in order to computer microscopic dose distribution around particulate α-emitters. This theoretical dosimetric approach will provide a scientific basis to the extrapolation of results of animal experiments utilizing high doses to man exposed to low level radioactivity and also to the understanding of biological effects associated with high LET radiations. Lung cells which survive α-particle hits were calculated, which will be a significant index of potential risk. Three models were assumed for the structure of parenchymal lung, which were (1) structureless lung of uniform density, (2) lattice of honeycomb pattern and (3) digital image of actual histological section of rat lung. The result shows that the survival cells decrease exponentially with the diameter of inhaled particles in any models. But the slope of the curve for the structureless lung is much greater than those for any other two models. This result suggests the validity of the dosimetric approach using actual histological section to estimate the inhalation risk of particulate α-emitters. (author).

**35126** (NIRS-M–78, pp. 199-212) **Life-span studies of inhaled plutonium in beagle dogs.** Bair, W.J. (Pacific Northwest Lab., Richland, WA (USA)). National Inst. of Radiological Sciences, Chiba (Japan). Mar 1991. (CONF-891290–: 21. annual NIRS symposium on inhalation of airborne particles and induction mechanisms, Chiba (Japan), 7-9 Dec 1989). In *Inhalation of airborne particles and mechanisms for induction of biological effects.* 271p. Order Number DE91508518. Source: OSTI; NTIS (US Sales Only); INIS.

In 1970 a life-span study with over 300 beagle dogs was begun. Groups of beagle dogs were given single exposures to $^{239}PuO_2$, $^{238}PuO_2$, or $^{239}Pu(NO_3)_4$ to obtain graded levels of initial lung burdens ranging from 1 to 1800 Bq lung. After 16 years, the lungs contained about 2% of the initial lung burden of $^{239}PuO_2$, the thoracic lymph nodes 20%, skeleton 1% and liver 10%. After 15 years the lungs contained about 0.2% of the initial lung burden of $^{238}PuO_2$, thoracic lymph nodes 5%, skeleton 10%, and liver 10%. After 10 years the lungs contained about 0.29% of the initial lung burden of $^{239}Pu(NO_3)_4$, thoracic lymph nodes 0.17%, skeleton 18% and liver 13%. Chronic lymphopenia has been one of the earliest biological effects observed. Other effects associated with plutonium exposure included sclerosis of the tracheobronchial lymph nodes, focal radiation pneumonitis, adenomatous hyperplasia of the liver and dystrophic osteolytic lesions in the skeleton. In 16 years, mortality due to radiation pneumonitis and/or lung tumor increased with deposition of 24 Bq of $^{239}PuO_2$. In 15 years, mortality due to lung and/or bone tumors increased with deposition of 96 Bq of $^{238}PuO_2$. In 11 years, after exposure, mortality due to lung and/or bone tumors increased with deposition of 18 Bq of $^{239}Pu(NO_3)_4$. Lung cancers appeared to originate in the parenchymal regions of the lungs and were of several types; bronchiolar alveolar carcinoma, papillary adenocarcinomas, adenosquamous carcinoma, and epidermoid carcinoma. Metastases were primarily to the thoracic lymph nodes. Sites of osteosarcomas in the $^{238}PuO_2$ and $^{239}Pu(NO_3)_4$ dogs were in the lumbar cervical and thoracic vertebrae, humerus, pelvis, facial bones, ribs and nasal turbinates.

**35127** (UCRL-CR–104682-Rev.1) **Technical basis document for internal dosimetry: Revision 1.** Hickman, D.P. (Chem-Nuclear Geotech, Inc., Grand Junction, CO (United States)). Lawrence Livermore National Lab., CA (United States); Chem-Nuclear Geotech, Inc., Grand Junction, CO (United States). Sep 1991. 82p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (DOE/ID/12584–77). Order Number DE91018834. Source: OSTI; NTIS; INIS; GPO Dep.

This document provides the technical basis for the Chem-Nuclear Geotech (Geotech) internal dosimetry program. Geotech policy describes the intentions of the company in complying with radiation protection standards and the "as low as reasonably achievable" (ALARA) program. It uses this policy and applicable protection standards to derive acceptable methods and levels of bioassay to assure compliance. The models and computational methods used are described in detail within this document. From these models, dose- conversion factors and derived limits are computed. These computations are then verified using existing documentation and verification information or by demonstration of the calculations used to obtain the dose-conversion factors and derived limits. Recommendations for methods of optimizing the internal dosimetry program to provide effective monitoring and dose assessment for workers are provided in the last section of this document. This document is intended to be used in establishing an accredited dosimetry program in accordance with expected Department of Energy Laboratory Accreditation Program (DOELAP) requirements for

the selected radionuclides provided in this document, including uranium mill tailing mixtures. Additions and modifications to this document and procedures derived from this document are expected in the future according to changes in standards and changes in programmatic mission. 20 refs., 22 figs., 60 tabs.

## 5603 Chemicals Metabolism and Toxicology

*Refer also to citation(s) 35006, 35073, 35096, 35119*

**35128** (ANL/CP–72578) **Cadmium-induced bone loss: increased susceptibility in female beagles after ovariectomy.** Bhattacharyya, M.H.; Sacco-Gibson, N.A.; Peterson, D.P. Argonne National Lab., IL (United States). [1991]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9109265–1: Toxicity and carcinogenicity of cadmium in the human environment international symposium, Gargnano (Italy). 25-27 Sep 1991). Order Number DE91018623. Source: OSTI; NTIS; GPO Dep.

Bone resorption, as measured by release of bone $^{45}Ca$, was significantly increased in elderly female beagles within 96 h of exposure to 15 mg/L Cd in drinking water. The $^{45}Ca$ response was greater in ovariecotomized (OV) animals than in sham-operated (SO) controls and was not mediated by changes in calciotropic hormone concentrations. Mean blood Cd concentrations were 3–8 $\mu$g/L during the earliest bone resorption response and 13–15 $\mu$g/L at the end of the study. During 7 mo of Cd exposure, bone mineral densities decreased most in the OV animals exposed to Cd: $-15.4 \pm 4.3\%$ for the tibia distal end and $-7.2 \pm 1.2\%$ for the lumbar vertebrae (L2-L4) (mean $\pm$ SE, n=4). Results indicate that Cd may act directly on bone and that postmenopausal women exposed to Cd in industry or via cigarette smoke may be at increased risk of Cd-induced bone loss. 21 refs., 4 figs.

**35129** (CONF-911246–1) **Benzene dosimetry in experimental animals: Relevance for risk assessment.** Henderson, R.F. (Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (United States). Inhalation Toxicology Research Inst.); Sabourin, P.J.; Medinsky, M.A.; Birnbaum, L.S.; Lucier, G.L. Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (United States). Inhalation Toxicology Research Inst. [1991]. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76EV01013. From Relevance of animal studies to evaluate human cancer risk conference; Austin, TX (United States); 5-8 Dec 1991. Order Number DE91017482. Source: OSTI; NTIS; GPO Dep.

In two-year, oral bioassay studies of the carcinogenicity of benzene conducted in F344 rats and B6C3F$_1$ mice, the mice developed a greater number and variety of tumors than did the rats. To aid in the use of these animal data to predict health risks for humans exposed to benzene, a series of studies were conducted to determine the effect of species, dose, and route and rate of exposure on the distribution and metabolic fate of benzene. The objective of the studies was to determine if the dosimetry of benzene and its metabolites could help to explain the species' differences in response to benzene. 20 refs., 5 figs., 8 tabs.

**35130** (CONF-911246–2) **The utility of animal inhalation studies to assess the risk of mineral fiber-induced pulmonary cancer.** Johnson, N.F. Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (United States). Inhalation Toxicology Research Inst. [1991]. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76EV01013. From Relevance of animal studies to evaluate human cancer risk conference; Austin, TX (United States); 5-8 Dec 1991. Order Number DE91017483. Source: OSTI; NTIS; GPO Dep.

Animal inhalation exposures to fibrous materials such as crocidolite and erionite produce lesions similar to those found in exposed humans. This indicates that the animal inhalation model is relevant for identifying hazardous fibrous materials. Intratracheal instillations and intracoelomic injections are alternative bioassays that can be used to screen for the most biologically active materials. These nonphysiological routes of administration can give false positive results; therefore, animal inhalation studies should be the ultimate bioassay used in the absence of appropriate epidemiological data. 46 refs., 3 tabs.

**35131** (ETDE-mf–2704338) **Multi-phase system for monitoring and mapping forest disease making use of all available remote sensing data sources. Final report B1.** Akca, A.; Rhein, M.; Schnurr, J. Goettingen Univ. (Germany). Inst. fuer Forsteinrichtung und Ertragskunde; Bundesministerium fuer Forschung und Technologie, Bonn (Germany). Sep 1990 35p. (In German). Contract BMFT 0339072A. Order Number DE92704338. Source: OSTI; NTIS (US Sales Only).

On the basis of remote sensing data from the Hils forest, the practical usefulness of a method for diagnosing forest disease symptoms was tested. Testing covered CIR aerial photographs, sets of data from the airborne scanners BENDIX and DAEDALUS; LANDSAT/TM scenes, and a panchromatic SPOT scene. A low-altitude flight using the DAEDALUS sensor aimed to verify the individual relationship between the vitality of crowns of spruces and differences in their spectral signatures. For this purpose, re-identifiable trees were classified by terrestrian surveying of harm and by CIR aerial photographs and were defined as training spots for the scanner scene. Investigated were the relations between the objects and their special signatures as a function of topographic and vegetation-specific factors. The multispectral data obtained using different methodics were interpreted with the aid of 'Hils', a forest-geographic information system. It provided the possibility for stratified treatment of these data according to object and lighting categories; this again, in combination with a forest management data base for this specific area, led to enhanced classification results and better operating efficiency for forest disease research. The results and juxtapositions of different classifications of stands and categories of harm are described against the background of their mathematical evaluation methodics and methodological problems. (IH).

**35132** (ETDE-mf–2704458) **Subproject: Cancerogenicity assessment of PAH of environmental and workplace relevance after intrapulmonary administration in rats.** Wenzel-Hartung, R. Biologisches Lab. Dr. med. H. Brune, Hamburg (Germany); Bundesminjsterium fuer Forschung und Technologie, Bonn (Germany). Oct 1988 14p. (In German). Contract BMFT 01HK764. Order Number DE92704458. Source: OSTI; NTIS (US Sales Only).

For a comparative study with the cancerogenicity of BaT (benzo(a)pyrene), three-months-old female Osborne-Mendel rats received a single intrapulmonary administration of the polycyclic aromatic hydrocarbons PHE (phenanthrene), CHR (chrysene), and BNT (benzo(b)naphtho(2,1-d)thiophene) at different dosages at baseline. Whereas a squamous cell carcinoma was observed for PHE only in the highest dose group (10 mg), a dose-dependent tumour incidence was found for CHR after implantation. The test model also established a cancerogenic action for BNT, while a similar efficacy for tumour induction was for its mean (3 mg) and high (6 mg) doses. Compared with CHR and BNT, the highest cancerogenicity was found for BaP which resulted in a clear dose-effect relationship. To trigger a similar carcinoma incidence as that of BaP, both CHR and BNT would have to be implanted into the rat lungs at a quantity higher by at least a factor of 30. (orig.).

**35133** (INIS-mf–14008) **Environment and cancer.** Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

Apart from a start introduction, the study contains 15 papers on the carcinogenetic effects of environmental pollutants and environmental radioactivity, the molecular-biological fundamentals of tumor genesis and the available methods by which the carcinogenic effects of substances can be proved. 12 of the papers can be searched as separate records in the database. (MG).

**35134** (INIS-mf–14008, pp. 11-14) **The role of carcinogens in tumor promotion.** Rahmsdorf, H.J. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.)); Ponta, H.; Herrlich, P. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn

(Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

The role of two groups of environmental noxes in the formation of tumors in men and animals and in the tumorigenic transformation of cells in culture are currently discussed intesively: (i) DNA damaging agents, which because of their cancer inducing properties are also designated as carcinogens; and (ii) tumor promoters, which by themselves are only weakly carcinogenic but enhance strongly the action of carcinogens. Ultraviolet irradiation, Y-radiation and many chemicals are potent carcinogens; the most potent tumor promoters are found between various plant metabolites, as e.g. phorbol esters (croton oil). We are going to show that the primary action of both groups of substances on mammalian cells is quite similar: The activation of specific genes. We are going to summarize the arguments which suggest that the activation of some of these genes plays a causative role in tumorigenesis. The genetic program induced by carcinogens and by tumor promoters leads to an enhanced mutability also in those cells, which have not been exposed to these substance. (orig.).

**35135** (INIS-mf–14008, pp. 19-22) **New methods for toxicokinetic studies on chemicals carcinogens by means of analysis of DNA damage.** Pool-Zobel, B.L. (Bundesforschungsanstalt fuer Ernaehrung, Karlsruhe (Germany, F.R.)); Brendler, S.Y.; Liegibel, U.; Kuchenmeister, F.; Schmezer, P. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

For investigating the potential carcinogenic properties of chemicals or for elucidating their mechanisms of activities, it is as important to determine their DNA damaging effects as it is to determine their mutagenicity. In the following, three methods will be presented which may be utilized to detect chemically induced DNA damage. These are the classical DNA filter elution procedure (AE), the in situ nick translation (NT), and the single cell microgel-electrophoresis (MGE) assay. Latter two methods have the advantage that they will allow genotoxic effects to be determined in many organs of the experimental animals, since only minute quantities of tissue are needed. Therefore it is possible to efficiently obtain data pertaining to the toxicokinetics of the test chemical which may be used for purposes of risk assessment. (orig.).

**35136** (INIS-mf–14008, pp. 7-10) **Formation and repair of DNA damage due to alkylating agents in human cells.** Kaina, B. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.)). Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

Alkylating agents are versatile environmental mutagens and carcinogens. They act spontaneously or after metabolic activation with cellular nucleophilic constituents giving rise to at least twelve different DNA alkylation products. The main premutagenic and precarcinogenic alkylation product, $O^6$-alkylguanine, is removed from DNA in a single step reaction by the alkyltransferase protein. The repair of N-alkylation products is accomplished by the concerted action of serveral enzymes which excise these lesions from DNA. A defect in the repair of $O^6$-alkylguanine has been cured successfully by insertion and expression of the bacterial alkytransferase gene into Chinese hamster and human cells. (orig.).

**35137** (INIS-mf–14008, pp. 23-26) **Quantitative assessment of preneoplastic foci for evaluation of carcinogenic potential of chemicals.** Zerban, H. (Deutsches Krebsforschungszentrum, Heidelberg (Germany, F.R.)); Bannasch, P. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

Up to the present the evaluation of the carcinogenic potential of chemical compounds mainly depends on the histological demonstration of manifest malignant neoplasia induced in animals during long-term experiments. In various tissues, especially in the liver of different species, phenotypically altered preneoplastic cell populations (preneoplastic foci) can be detected by cytomorphological and cytochemical methods, which emerge long before the appearance of tumors. Using N-nitrosodiethanolamine, a chemical compound with a considerable importance as an environmental contaminant, as an example, we demonstrate that the quantitation of such preneoplastic lesions permits the assessment of the carcinogenic efficiency of this compound. Risk assessment by this methodological approach is not only possible at earlier time points but also as for such low carcinogenic doses which do not induce tumors during the expected life time of the animals. In accordance with the reports of other laboratories the results suggest that the preneoplastic focal lesions may well be used as endpoints in carcinogenicity testing. The detection and quantitation of preneoplastic foci may considerably improve the evaluation of carcinogenesis bioassays and save both animals and time. (orig.).

**35138** (INIS-mf–14008, pp. 27-33) **Population exposure to dioxins.** Greim, H. (GSF - Forschungszentrum fuer Umwelt und Gesundheit GmbH, Neuherberg (Germany, F.R.)); Sterzl, H. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

The average exposure of the population in the Federal Republic of Germany - mainly by ingestion of food containing fat - is at present about 1.3 pg TCDD toxicity equivalents (TE) kg body weigth per day, thus leading to a body fat concentration of about 40 mg TE/kg adipose tissue. Human milk also contains these substances. As a result babies are exposed to more than the 100-fold of the tolerable daily intake of 1 pg/kg body weight. The health hazard of PCDD/F may have been overestimated because symptoms of disease were not observed until the concentration in fat reached values of several thousand nanograms/kg adipose tissue. Furthermore environmental exposure estimated in areas adjacent to emission are too low to lead to overt human disease. Nevertheless the known sources of contamination such as waste incineration, industrial combustion processes, automobil exhausts, fossil fuel combustion or processes such as production of chlorinated compounds should be reduced to the lowest possible levels. (orig./MG).

**35139** (INIS-mf–14008, pp. 34-37) **Risk assessment of environmental pollutants: The significance of the multistep theory of carcinogenesis.** Schwarz, M. (Deutsches Krebsforschungszentrum, Heidelberg (Germany, F.R.)); Buchmann, A. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

According to our present knowledge, tumor cells develop from normal cells through a sequence of several rate-limiting steps. Agents which increase the risk of cancer may thereby act on different stages during this process. While tumor-initiating chemicals may induce critical mutations in the target cells and thus increase the transition rates from normal to preneoplastic cells and from preneoplastic to tumor cells, tumor-promoting compounds are assumed to accelerate the carcinogenic process by increasing the proliferation rate of preneoplastic cells. Knowledge on differences in the mechanism of action between tumor-initiating and tumor-promoting agents is of importance for the development of models used for the assessment of possible risks associated with exposure of humans to low concentrations of these chemicals. (orig.).

**35140** (INIS-mf–14008, pp. 45-48) **Statistical analysis of the Saarland region - air pollution and lung cancer.** Grueger, J. (Dornier GmbH, Friedrichshafen (Germany, F.R.)); Schaefer, T. Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF), Bonn (Germany). 1990. 63p. (In German). (CONF-9012111–: 12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer, Bonn (Germany), 13-14 Dec 1990). In *Environment and cancer.* Order Number DE92704409. Source: OSTI; NTIS (US Sales Only); INIS.

An ecological analysis of associations between pollution of ambient air at place of residence and lung cancer on the basis of the Cancer Atlas of Saarland is presented. In the analysis three main risk factors of lung cancer on ecological level can be identified: Smoking habits, sociodemographic class, ambient air pollution. Results can be reproduced coherently for different sub-locations, in different sub-populations and time-periods and for both sexes. Thus the association must be regarded as statistically significantly validated at the ecological level. The effect of a simultaneously considered indicator for professional exposition was not statistically significant in the multifactorial approach due to strong suppression by the other predictors. (orig.).

**35141** (LA–12184-MS) **Biological effects of minerals.** Guthrie, G.D. Jr. Los Alamos National Lab., NM (United States). Sep 1991. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE91018183. Source: OSTI; NTIS; GPO Dep.

In general, clay materials exhibit a range of biological activities, from apparently inactive or slightly active, such as hematite, to highly fibrogenic and carcinogenic, such as fibrous brucite (nemalite). The zeolites also exhibit such as range, with some mordenite being slightly active and erionite being highly active; however, erionite is the only zeolite that has been studied extensively. The diversity of mineral species holds great potential for probing these mechanisms, especially when mineralogical data are integrated with biological data. Unfortunately, many of the studies reporting data on the biological effects of clays and zeolites fail to report detailed mineralogical information; hence, it is difficult at present to interpret the biological activities of minerals in terms of their physical and chemical properties. Important mineralogical data that are only rarely considered in biological research include exact mineralogy of the specimen (i.e., identification and abundance of contaminants), physical and chemical properties of minerals, and surface properties of minerals. 141 refs., 1 fig., 8 tabs.

### 5604 Other Environmental Pollutant Effects

*Refer also to citation(s) 35115*

**35142** (LBL–31097) **Electromagnetic field effects on cells of the immune system: The role of calcium signalling.** Walleczek, J. Lawrence Berkeley Lab., CA (United States). Jul 1991. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9104107–1: 75. annual meeting of the Federation of American Societies for Experimental Biology (FASEB), Atlanta, GA (United States), 21-25 Apr 1991). Order Number DE92000852. Source: OSTI; NTIS; GPO Dep.

During the past decade considerable evidence has accumulated demonstrating the exposures of cells of the immune system to relatively weak extremely-low-frequency (ELF) electromagnetic fields (< 300 Hz) can elicit cellular changes which might be relevant to in-vivo immune activity. However, knowledge about the underlying biological mechanisms by which weak fields induce cellular changes is still very limited. It is generally believed that the cell membrane and $Ca^{2+}$ regulated activity is involved in bioactive ELF field-coupling to living systems. This article begins with a short review of the current state of knowledge concerning the effects of nonthermal levels of ELF electromagnetic fields on the biochemistry and activity of immune cells, and then closely examines new results which suggest a role for $Ca^{2+}$ in the induction of these cellular field effects. Based on these findings it is proposed that membrane-mediated $Ca^{2+}$ signalling processes are involved in the mediation of field effects on the immune system. 64 refs., 2 tabs.

## 57 HEALTH AND SAFETY

*Refer also to citation(s) 34930, 35127, 35487, 35561*

## 58 GEOSCIENCES

*Refer also to citation(s) 33645, 33646, 33654, 33736, 33786, 33788, 33790, 33849, 33912, 33913, 34243, 34999, 35000, 35001, 35020, 35026, 35036, 35051, 35056, 35061, 35064, 35075, 35076, 35086*

**35143** (CONF-9110122–7) **Development of site-specific synthetic accelerations for safety assessment of DOE facilities at Oak Ridge, Tennessee.** Aramayo, G.A.; Carley, T.G.; Jones, W.D. Oak Ridge National Lab., TN (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Natural phenomena hazards mitigation conference; St. Louis, MO (United States); 15-18 Oct 1991. Order Number DE92000068. Source: OSTI; NTIS; GPO Dep.

Seismic analysis of US Department of Energy (DOE) facilities at Oak Ridge, TN, requires seismic accelerograms that have response spectra that are compatible with the site-specific design response spectra. The development of these accelerograms is accomplished by the application of the Fourier transform to compute the response spectrum of a beginning accelerogram and map it into the frequency domain. The Fourier spectrum is modified according to the difference between the computed spectra and the target spectra. The response spectrum is recomputed and compared again to the target. The modification is repeated until acceptable agreement is achieved. The modified Fourier spectrum is transformed to the time domain and filtered yielding the desired seismic time history. 7 refs., 5 figs.

**35144** (DOE/ER/14079–10) **Three-dimensional explicit depth migration via McClellan transformations on hexagonal sampling grids.** Hedley, J.P. Colorado School of Mines, Golden, CO (United States). Center for Wave Phenomena. Jun 1991. 36p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-89ER14079. (CWP–110). Order Number DE91017370. Source: OSTI; NTIS; GPO Dep.

The computational cost of three-dimensional depth migration depends almost entirely on the cost of depth extrapolation. Each frequency of a 3-D seismic wavefield can be extrapolated by two-dimensional filters that vary spatially according to frequency and velocity. 2-D extrapolation filters are efficiently designed and implemented by use of McClellan transformations. McClellan transformations convert 1-D extrapolation filters to approximately circularly symmetric 2-D extrapolation filters at computational cost that is proportional to the number of unique coefficients, N, in the 1-D extrapolation filters. In contrast, the cost of direct convolution of 2-D extrapolation filters is proportional to $N^2$. Imaging of steep digs requires long extrapolation filters, i.e., large N, making direct 2-D convolution very expensive. Although efficient, McClellan transformations only approximate circularly symmetric 2-D filters for depth extrapolation. The accuracy of a 2-D extrapolation filter can be improved only at an increase in the cost of implementing that filter. By applying McClellan transformations on a hexagonal sampling grid, the accuracy of 2-D extrapolation filters can be improved at a reduction in cost. Furthermore, hexagonal sampling grids are the most efficient for spatially circularly band-limited seismic data, reducing the number of samples that are repeatedly processed during recursive, depth extrapolation. 17 refs., 30 figs.

**35145** (DOE/EV/72012–T1) **Geochemical baseline data, Youngs Bay, Oregon, 1974: Final report, 1 November 1973–30 April 1975.** McMechan, K.J. (ed.); Johnson, V.G.; Cutshall, N.H. Oregon State Univ., Corvallis, OR (United States). School of Oceanography. Apr 1975. 66p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AT06-76EV72012. Order Number DE92000530. Source: OSTI; NTIS; GPO Dep.

This report comprises one part of a final report to the Alumax Pacific Aluminum Corporation on the "Physical, Chemical and Biological Studies of Youngs Bay". The data reported herein are the product of the geochemical baseline section of the project. The primary objectives of the geochemical study were: to provide a

baseline record of fluoride and selected trace metal levels in Youngs Bay bottom sediment, to identify areas that might function as heavy metal traps, to attempt to determine the recent depositional history of sediment in the bay. In addition to these primary objectives, a number of secondary tasks were undertaken during the study. While time did not allow these additional studies to be carried to completion, preliminary results are included herein because of their potential usefulness in assessing the impact of environmental releases of fluoride to aquatic systems in the vicinity of Youngs Bay or elsewhere. This report is made up of two major sections. In the first, a description of sample collection and analytical procedures is followed by a discussion of the baseline results. Obvious vertical and horizontal patterns of elemental distribution are identified and their origins considered. Problems needed further research are also discussed. In the second section, the data are presented in interpretive, graphical form, as well as in tables. 35 refs., 29 figs., 14 tabs.

**35146** (DOE/ID–12118) **Climatography of the Idaho National Engineering Laboratory: Second edition.** Clawson, K.L.; Start, G.E.; Ricks, N.R. (eds.). National Oceanic and Atmospheric Administration, Idaho Falls, ID (United States). Air Resources Lab. 1 Dec 1989. 155p. Sponsored by USDOE, Washington, DC (United States); National Oceanic and Atmospheric Administration, Washington, DC (United States). Order Number DE91018697. Source: OSTI; NTIS; GPO Dep.

Second edition of IDO–12048 issued in 1966.

Numerous research and climatological reports have been published about the Idaho National Engineering Laboratory (INEL) by the Field Research Division of the Air Resources Laboratory, or the various agency names under which this office has operated. Several preliminary reports were prepared in the later 1940's which described the expected climatology of the INEL. The first series of reports using meteorological data acquired on-site was published during the time period from 1958 to 1960. A major addition to that original body of climatological literature was the first edition of the "Climatography of the National Reactor Testing Station." Each of these reports were written primarily to: (1) provide engineers, health physicists, scientists, and other researchers with a source of meteorological information pertinent to designing, locating, and operating nuclear reactors and support facilities, and (2) provide insight into the atmospheric aspects of health physics. The second edition of the INEL climatography builds significantly on the material found in its predecessor. It is not, however, intended to be a replacement of all preceding climatological documents. It also does not provide guidance describing methods whereby the climatological data are to be utilized. Nevertheless, most of the meteorological and climatological information needed for the purpose of assessing the location, the design, and the operation of facilities within the setting of the INEL are provided. 32 refs., 66 figs., 52 tabs.

**35147** (DOE/SF/15522–T1) **UCSD Geothermal Chemistry Program, FY 1989: Final annual progress report.** Weare, J.H. California Univ., San Diego, La Jolla, CA (United States). Dept. of Chemistry. [1989]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-85SF15522. Order Number DE91018951. Source: OSTI; NTIS; GPO Dep.

The behavior of concentrated brines cannot be predicted from first principle theories. However, because of the importance of these fluids to many industrial and natural processes, there has been a continuing effort to develop phenomenological approaches which can be parameterized from empirical data. The model we are developing incorporates the most successful of these proposed by Pitzer and co-workers. We have shown that using this approach we can create models of brine chemistry which are highly accurate. These models are parameterized by very careful fitting of experimental measurements and require extensive data sets. However, the required data is for systems of considerably less complication than those found in field applications and in many cases is readily available. 7 refs.

**35148** (EGG-BG–9249) **Strong ground motion data recorded at the Idaho National Laboratory during the 1983 Borah Peak, Idaho earthquake.** Jackson, S.M.; King, J.J.; Anderson, D.M.; Carpenter, G.S.; Adams, H.A. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jun 1991. 136p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018744. Source: OSTI; NTIS; GPO Dep.

The Idaho National Engineering Laboratory (INEL) is located approximately 80 km southeast of the epicenter for the 1983 $M_S$ 7.3 Borah Peak Idaho earthquake. Thirteen strong-motion accelerographs located at various facilities around the INEL Site recorded strong-ground motions from the Borah Peak earthquake. The strong-motion records were digitized and processed resulting in corrected acceleration, velocity, and displacement time-histories and response and Fourier spectra. Peak horizontal accelerations had a range of 0.022 to 0.078 g for accelerographs located at free-field and basement sites. Values of 0.037 – 0.817 g were recorded at accelerographs located within structures above basement level. Peak vertical accelerations ranged from 0.16 (basement level) to 0.059 g (top of structures). The peak amplitudes of the response and Fourier Spectra occur in the 2 – 10 hz frequency range. Appendices include Borah Peak earthquake accelerograph data printouts. 8 refs., 4 figs., 7 tabs.

**35149** (EUR–13406) **Catalogue of European earthquakes with intensities higher than 4.** Van Gils, J.M. (Federal Institute for Geosciences and Natural Resources, Hannover (DE)); Leydecker, G. Commission of the European Communities, Luxembourg (Luxembourg). 1991. 353p. Source: OSTI; NTIS (US Sales Only).

The catalogue of European earthquakes with intensities higher than 4 contains some 20 000 seismic events that happened in member countries of the European Communities, Switzerland and Austria. It was prepared on the basis of already existing national catalogues and includes historical data as well as present-day data. All historical data are harmonized as far as possible to the same intensity scale (MSK-scale) to make them suitable for computerization. Present-day data include instrumental and macroseismic data. Instrumental data are expressed in terms of magnitude (Richter scale) while macroseismic data are given in intensities. Compilation of seismic data can provide a basis for statistically supported studies of site selection procedures and the qualitative assessment of seismic risks. Three groups of seismic maps illustrate the content of the catalogue for different time periods and different intensities.

**35150** (INIS-BR–2698) **K-Ar cooling age profile from Joinville massif (PR and SC, Brazil) and Dom Feliciano belt (SC, Brazil) - Tectonics entanglement.** Siga Junior, O. (Sao Paulo Univ., SP (Brazil). Inst. de Geociencias); Basei, M.A.S.; Kawashita, K. Sociedade Brasileira de Geologia, Recife, PE (Brazil). Nucleo do Nordeste. 1990 14p. (In Portuguese). (CONF-9010404–: 36. Brazilian congress of geology, Natal (Brazil), 28 Oct - 1 nov 1990). Order Number DE92601128. Source: OSTI; NTIS (US Sales Only); INIS.

A K-Ar cooling age profile using different minerals from metamorphic rocks of the Joinville Massif and Dom Feliciano Belt is presented. Three main geochronological domains are distinguishable, from NW to SE: (1) Northern part of the Joinville Massif (NJM); (2) Southern part of the Joinville Massif (SJM) and (3) Dom Feliciano Belt (DBF). Geochronological domains 1 and 3 yielded K-Ar values in the range 800-500 Ma and 700-500 Ma, respectively, which show a clear influence of the Brasiliano Cycle. The granulite terrain comprising the SMJ exhibits ages older than 1700 Ma, indicating that this area was cool during the Late Proterozoic Brasiliano Cycle. The SJM and NJM limit is marked by a rapid Transition from Early Proterozoic ages in the SJM to Late Proterozoic ages in the NJM. On the other hand the contact between the SJM and DFB is interpreted as a thrust at a high, relatively cool crustal level. (author).

**35151** (LBL–29700) **Earth Sciences Division annual report 1990.** Lawrence Berkeley Lab., CA (United States). Jun 1991. 197p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000647. Source: OSTI; NTIS; GPO Dep.

This Annual Report presents summaries of selected representative research activities grouped according to the principal disciplines of the Earth Sciences Division: Reservoir Engineering and Hydrogeology, Geology and Geochemistry, and Geophysics and Geomechanics. Much of the Division's research deals with the physical and chemical properties and processes in the earth's crust, from the partially saturated, low-temperature near-surface

environment to the high-temperature environments characteristic of regions where magmatic-hydrothermal processes are active. Strengths in laboratory and field instrumentation, numerical modeling, and in situ measurement allow study of the transport of mass and heat through geologic media – studies that now include the appropriate chemical reactions and the hydraulic-mechanical complexities of fractured rock systems. Of particular note are three major Division efforts addressing problems in the discovery and recovery of petroleum, the application of isotope geochemistry to the study of geodynamic processes and earth history, and the development of borehole methods for high-resolution imaging of the subsurface using seismic and electromagnetic waves. In 1989 a major DOE-wide effort was launched in the areas of Environmental Restoration and Waste Management. Many of the methods previously developed for and applied to deeper regions of the earth will in the coming years be turned toward process definition and characterization of the very shallow subsurface, where man-induced contaminants now intrude and where remedial action is required.

35152 (ORNL/TM–11897) **Assessment of the 1988 Saguenay earthquake: Implications on attenuation functions for seismic hazard analysis: Revised draft report.** Toro, G.R. (Risk Engineering, Inc., Golden, CO (United States)); McGuire, R.K. Oak Ridge National Lab., TN (United States); Pickard, Lowe and Garrick, Inc., Newport Beach, CA (United States). Sep 1991. 69p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000453. Source: OSTI; NTIS; GPO Dep.

This study investigates the earthquake records from the 1988 Saguenay earthquake and examines the implications of these records with respect to ground-motion models used in seismic-hazard studies in eastern North America (ENA), specifically, to what extent the ground motions from this earthquake support or reject the various attenuation functions used in the EPRI and LLNL seismic-hazard calculations. Section 2 provides a brief description of the EPRI and LLNL attenuation functions for peak acceleration and for spectral velocities. Section 2 compares these attenuation functions the ground motions from the Saguenay earthquake and from other relevant earthquakes. Section 4 reviews available seismological studies about the Saguenay earthquake, in order to understand its seismological characteristics and why some observations may differ from predictions. Section 5 examines the assumptions and methodology used in the development of the attenuation functions selected by LLNL ground-motion expert 5. Finally, Section 6 draws conclusions about the validity of the various sets of attenuation functions, in light of the Saguenay data and of other evidence presented here. 50 refs., 37 figs., 7 tabs.

35153 (UCRL-JC–108142) **Nonlinear attenuation effects outside the zone of macroscopic failure.** Bonner, B.P.; Wanamaker, B.J. Lawrence Livermore National Lab., CA (United States). 6 Aug 1991. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-890398–3: DOE/LLNL symposium on explosion-source phenomenology, Lake Tahoe, CA (United States), 14-16 Mar 1989). Order Number DE91018722. Source: OSTI; NTIS; GPO Dep.

Laboratory evidence unambiguously shows that the mechanical response of rock of low confining pressure is nonlinear, meaning that attenuation is strain-amplitude-dependent, for strains between $\sim 10^{-6}$ and those sufficient to cause permanent damage, $10^{-3}$ to $10^{-2}$. We compare the magnitude to nonlinear attenuation for soils, microscopically cracked granite, and macroscopically fractured granite. A compilation of data for attenuation in soils from the civil engineering literature documents the strong nonlinear response in these materials over the strain range $10^{-6}$ to $10^{-3}$. Nonlinear soil response would be most important in near surface layers. We show direct evidence that fatigue microcracking resulting from high-frequency and ultrasonic measurement techniques may lead to systematic overestimates of nonlinear attenuation. New data for attenuation due to sliding on a single macrofracture in granite shows that large attenuation (up to $Q^{-1} = 0.1$) can occur at strains of $5 \times 10^{-4}$ at low normal stress. Measurable nonlinear response attributable to the fracture persists to strains near $10^{-6}$ and to normal stresses corresponding to overburden pressures at typical burial depths for underground explosions. 32 refs., 6 figs.

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## 6401 Astrophysics and Cosmology

*Refer also to citation(s) 34593, 34857, 35184, 35266, 35376*

35154 (CEA-N–2660) **Backgrounds in the Gallex solar neutrino experiment.** Stolarczyk, T. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Direction des Sciences de la Matiere; Paris-11 Univ., 91 - Orsay (France). Mar 1991. 196p. (In French). Order Number DE92707157. Source: OSTI; NTIS (US Sales Only).

GALLEX is a radiochemical solar neutrino experiment installed in the Gran Sasso Underground Laboratory (Italy). It uses 30 tons of gallium in the form of a gallium chloride solution. The observation of the decay of $^{71}$Ge produced by neutrino interactions on the $^{71}$Ga atoms determines the solar neutrino flux. Since the reaction threshold is 233 keV, GALLEX is sensitive to neutrinos emitted by the initial hydrogen fusion reaction. GALLEX should contribute to the solution of the Solar Neutrino Problem, dating from the first results of the Chlorine Experiment in 1968 and confirmed in 1989 by Kamokiande II. A production rate of 1.2 germanium atom per day is expected. All backgrounds which may produce $^{71}$Ge atoms in the gallium tank, essentially $^{71}$Ga(p, n)$^{71}$Ge reactions, must therefore be carefully evaluated. In these reactions protons originate in cosmic muon interactions or fast neutron interactions on hydrogen or chlorine atoms in the solution. The muon induced background is calculated using the muon flux in the underground laboratory measured by the MACRO experiment and the germanium production cross section measured at CERN with a muon beam. The neutron background is measured using a calcium nitrate solution detector ($n + {}^{40}Ca \rightarrow {}^{37}Ar + \alpha$) where the $^{37}$Ar radio-isotopes are extracted and counted in the same way as in the chlorine experiment. These two phenomena induce a total background which does not exceed 3% of the signal, provided that the number of germanium atoms produced by solar neutrinos agrees which the prediction of standard solar models.

35155 (JINR-D–4-89-221) **Proceedings of workshop on the development and construction of gravitational wave emitter and detector.** Joint Inst. for Nuclear Research, Dubna (USSR). 1989. 154p. (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers are indexed.

35156 (JINR-D–4-89-221, pp. 5-12) **Gravitational wave experiment - problems and perspectives.** Bogolyubov, P.N. (Joint Inst. for Nuclear Research, Dubna (USSR)); Pisarev, A.F. Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

An effort to realize the program on setting a complete laboratory experiment on gravitational waves using the principle of parametric wave transformation in the material medium in the JINR is considered. Technical difficulties which are not yet overcome in solving this complex problem are analyzed. New ways of experimental realization of gravitational wave emitter-receiver closed scheme are discussed as well. 20 refs.

35157 (JINR-D–4-89-221, pp. 30-37) **Relativistic extended objects.** Shavokhina, N.S. (Joint Inst. for Nuclear Research, Dubna (USSR)). Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Two relativistic extended objects are considered. One of them describes the motion of two similar material points with constant gravitation. Another one leads to the de Sitter motion of the world.

As follows from the least action principle, extended relativistic structures of finite dimensions in the form of de Sitter Universe and spherical membranes can exist and develop in the metric space-time. In this case the de Sitter Universe radius depends on the dimension of space-time. 20 refs.

**35158** (JINR-D–4-89-221, pp. 102-114) **Theory of second order tide forces and gravitational wave experiment.** Tammelo, R.R. (AN Ehstonskoj SSR, Tartu (USSR). Inst. Fiziki). Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Theory of tide forces square by vector radius is presented. The mechanism of $10^{18}$ time gravitational wave pressure increase in case of radiation from pulsars and $10^{15}$ time one in case of standard burst of radiation from astrophysical catastrophe is proposed. This leads to secular shifts of longitudinally free receivers by $10^{-16}$ cm during $10^5$ s in the first case and by $10^{-19}$ cm during 10 s in the second one. A possibility of increase effect modulation is available. It is indicated that it is possible to construct a device which produces more energy at the expense of square tide forces than at the expense of linear ones. 21 refs.

**35159** (JINR-D–4-89-221, pp. 115-122) **Optical-fiber interferometric antenna for search of gravitational waves of astrophysical nature.** Vasilenko, A.T. (Joint Inst. for Nuclear Research, Dubna (USSR)); Kalinin, A.I.; Lyablin, M.V. Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Design of a gravitational antenna for kHz range on the base of Mach-Zehnder interferometer, each arm of it applying one-mode $28 \times 10^3$ m length optical fiber, is presented. The antenna is planned to be commissioned in three stages. At the first one a quartz optical fiber produced by domestic industry will be used in the antenna. In this case the calculated antenna sensitivity at indoor temperature by shot noises will make up $\sim 6 \times 10^{-18}$ and by thermal ones - $\sim 10^{-15}$. Under liquid helium temperature and fiber submersion to dispersion medium the thermal noise is reduced down to the value of $\sim 10^{-20}$. 19 refs.; 3 figs.

**35160** (JINR-D–4-89-221, pp. 123-129) **On thermodynamic sensitivity of gravitational antenna on the base of fiber Mach-Zehnder interferometer.** Lyablin, M.V. (Joint Inst. for Nuclear Research, Dubna (USSR)); Pisarev, A.F.; Stepanov, A.D.; Shabalin, D.E.; Shcherbakov, A.G. Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Fluctuation of light phase occurence in a fiber Mach-Zehnder interferometer used as an antenna for gravitational wave recording in a kHz frequency range is discussed on the base of statistical physics and thermodynamics. Thermodynamic fluctuation of entropy and pressure appears to be the main source of phase fluctuation. It is shown that these fluctuations limit the sensitivity of opticofiber antenna. In particular, under 30 km arm length in interferometer and 10 K temperature the antenna sensitivity to dimensionless amplitude of a gravitational wave makes up $\sim 10^{-20}$. 9 refs.

**35161** (JINR-D–4-89-221, pp. 130-133) **Stable fiber interferometer.** Izmajlov, G.N. (Moskovskij Aviatsionnyj Inst., Moscow (USSR)); Nikolaev, F.A.; Ozolin, V.V.; Grigor'yants, V.V.; Chamorovskij, Yu.K. Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

The problem of construction the long-base Michelson interferometer for gravitational wave detection is discussed. Possible sources of noise and instability are considered. It is shown that evacuation of fiber interferometer, the winding of its arms on the glass ceramic bases, stabilization of radiation source frequency and seismic isolation of the base allow one to reduce its instability to the level, typical of mirror interferometer with the comparable optical base. 10 refs.; 2 figs.

**35162** (JINR-D–4-89-221, pp. 137-146) **Analysis of dynamics of laser destruction of transparent solid dielectric for problems of gravitational experiments.** Pisarenko, V.G. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Kibernetiki); Leonets, V.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

The problem of gravitation radiation excitation from monocrystal under effect of intensive light wave is considered. It is shown that the amplitude of outlet gravitation pulse radiation from the crystal depends on the optical properties of the crystal. The more the share of crystal volume with initial optical defects and radiation distortions of refraction index homogeneity and the crystal absorption index, the lower the gravitational field intensity on the crystal axis is. 17 refs.; 4 figs.

**35163** (JINR-D–4-89-221, pp. 147-152) **Possibility of gravitational wave detector production on the base of light diffraction.** Segizboev, T.I. (AN Tadzhikskoj SSR, Dushanbe (USSR). Fiziko-Tekhnicheskij Inst.). Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Gravitational wave detector based on the light diffraction is proposed. Under the gravitation wave incidence on an elastic rod standing acoustic oscillations are excited in it, which are then used as a diffraction grating for the light scattering. A detailed mathematical analysis of this detector is given. 1 ref.

**35164** (Juel–2446) **Chemical problems in comet simulation experiments KOSI. Contributions of Institut fuer Chemie 1 (Nuklearchemie), Forschungszentrum Juelich to Schwerpunktprogramm 'Kleine Koerper im Sonnensystem' of Deutsche Forschungsgemeinschaft DFG for the period 15 February 1989 to 17 February 1991.** Roessler, K. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Chemie 1 - Nuklearchemie; Deutsche Forschungsgemeinschaft, Bonn (Germany). Feb 1991. 55p. (In German). Contract DFG Ro 724/1-1. Order Number DE92714420. Source: OSTI; NTIS (US Sales Only).

The report informs on preparation of analog material for the comet simulation experiments KOSI in the big Space Simulator Chamber of Institut fuer Raumsimulation DLR-Koeln, and the preceding laboratory studies in Juelich. In three experiments KOSI-5 to 7, 'organic solids' were introduced: $CH_3OH$, charcoal, and kerogen. The cryohandling in glove boxes with $LN_2$ baths and the analysis of unirradiated standard and insolated main samples are described. Visual inspection of the interior of the analogs, analysis of concentration profiles of the components and test of material strength by drilling revealed an interesting phenomenon: Volatile components such as $CO_2$ or $CH_3OH$ do not only diffuse outoff the mineral-ice sample, but also into its colder interior. This inward diffusion leads to enrichment layers characterized by formation of brilliant crystallites or solidification to inner crusts. These layers are arranged in a way that the more volatile compounds recrystallize deeper in the interior, such as in a kind of 'thermochromatography'. The solidification by condensation in the interior is the stronger, the higher the content of solid material (minerals, carbon, kerogen) and negligible in pure $H_2O$-$CO_2$-ice samples. A VUV-source is applied in the space simulator to complete the light spectrum with respect

to the photons with kinetic energies up to 10 eV which are characteristic for the real solar spectrum but do not exist in the light from Xenon-lamps which constitute the source for the artifical sun in KOSI. Single constituents of the analog samples are tested for their behaviour during photolysis in a small vacuum chamber in KFA Juelich. Optical spectroscopy data of some of the solid constituents (olivine, montmorillonite, kerogen) of the KOSI-7 material is reported for many spectroscopic methods (transmission, reflexion, FTIR, FTRAMAN, photoacoustic detection etc.). (orig.).

**35165** (KEK-PR–90-1) **Proceedings of the fourth workshop on elementary-particle picture of the universe.** Hikasa, Ken-ichi; Nakamura, Takashi; Ohshima, Takayoshi; Suzuki, Atsuo (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). 1990. 285p. (CONF-8911321–: 4. workshop on elementary-particle picture of the universe, Tateyama (Japan). 22-25 Nov 1989). Order Number DE92713849. Source: OSTI; NTIS (US Sales Only); INIS.

The Fourth Workshop on Elementary-Particle Picture of the Universe was held at Tateyama National Rest House from November 22 to 25, 1989. The main purpose of this workshop focuses on most of current experimental and theoretical activities in non-accelerator particle physics and astrophysics. It is also aimed to promote effective collaborations between experimentalists and theorists in these fields. The solar neutrino problem and the dark matter problem are the most exciting subjects in the astroparticle physics. They threw some doubts on the standard theories of astrophysics and also particle physics. We picked up both problems in this workshop as main themes, and discussed what they are at present and how they can be solved. Cosmology gives stringent constraints on particle properties which are frequently plausible candidates to solve the astrophysical problems. However, it is scarce to argue about how to determine the cosmological parameters and their ambiguities. We had some talks for this subject given by astronomers. New experimental results and detector developments were also presented. The atmosphere of workshop was informal, and there were extensive discussions on the above subjects. We got the confirm response that experimental and theoretical research activities in astroparticle physics were increasing here in Japan. (J.P.N.).

**35166** (LA-UR–91-2911) **CYGNUS Collaboration contributions to the twenty-second ICRC.** Alexandreas, D.E. (California Univ., Irvine, CA (USA)); Biller, S.; Dion, G.M.; Lu, X.Q.; Yodh, G.B.; Berley, D.; Chang, C.Y.; Dingus, B.L.; Dion, C.; Goodman, J.A.; Haines, T.J.; Kwok, P.W.; Stark, M.J.; Williams, D.; Burman, R.L.; Hoffman, C.M.; Nagle, DLos Alamos National Lab., NM (United States). Aug 1991. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9108141–2-Exc.: International cosmic ray conference, Dublin (Ireland), 11-23 Aug 1991). Order Number DE92000258. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains short papers on the cygnus experiments on the detection of cosmic air showers from distant sources such as nebulae, galaxies, x-ray sources, etc. (LSP).

**35167** (LA-UR–91-2945) **Magnetic topology of coronal mass ejections based on ISEE-3 observations of bidirectional electron fluxes at 1 AU.** Phillips, J.L.; Gosling, J.T.; McComas, D.J.; Bame, S.J.; Feldman, W.C. Los Alamos National Lab., NM (United States). [1991]. 7p. Sponsored by Department of Defense, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109254–2: Solar connection with transient interplanetary processes (SOLTIP), Castle Liblice (Czechoslovakia), 30 Sep - 5 oct 1991). Order Number DE92000250. Source: OSTI; NTIS; GPO Dep.

The solar wind electron heat flux is carried primarily by superthermal "halo" electrons with energies at 1 AU of ~80 eV and greater. These halo electrons typically are beamed antisunward along the IMF, indicating effective magnetic connection to the Sun only in one direction. However, ISEE-3 electron observations at 1 AU show that counterstreaming halo beams, suggesting closed magnetic structures, prevail within CMEs. These structures might be magnetic "tongues," tied to the Sun at both ends, magnetically detached plasmoids, or perhaps complex flux rope structures. We present the results of analysis of ISEE-3 electron observations within 39 CMEs. Parameters analyzed include: the asymmetry between the counterstreaming beams, control by the IMF orientation, and the variation of the electron distributions as a particular CME convects past the spacecraft. We find that some CMEs contain nearly symmetric electron beams, while others are strongly asymmetric, and that beam propagating most nearly antisunward is generally dominant. The more nearly radial the IMF the greater is the symmetry between outward and inward beams. Trends observed as CMEs propagate past the spacecraft probably result primarily from the compression of the leading edge. We present examples of a previously unreported "strahl-on-strahl" distribution, suggesting continued magnetic connection to the corona, in which a narrow antisunward beam is superimposed on a broader beam. Preliminary results show that such spectra are present in a substantial fraction of the observed CMEs. Taken as a whole, our results appear to favor a tongue or flux rope scenario rather than a detached plasmoid.

**35168** (LA-UR–91-2963) **On adaptive grid computations of variable stars.** Cox, A.N.; Deupree, R.G.; Gehmeyr, M. Los Alamos National Lab., NM (United States). [1991]. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9105252–2: 11. annual Center for Nonlinear Studies (CNLS) conference, Los Alamos, NM (United States), 20-24 May 1991). Order Number DE92000221. Source: OSTI; NTIS; GPO Dep.

We show that the use of an implicit adaptive-grid technique is an efficient and up-to-date approach for the calculations of radial oscillations in variable stars. We chose as an illustrative example the radiative envelope of an RR Lyrae variable. For the hydrostatic initial model we compare the Lagrangean ratioed zoning with an adaptive-grid rezoning. We show that the adaptive-grid yields an optimal distribution of the mesh points in the sense that the relevant physical features, the H– and He 1–, He 2– ionization zones, are well resolved. For the hydrodynamical evolution we present the full-amplitude model for both the Lagrangean and adaptive-grid computations. We perform a detailed comparison and show that the adaptive-grid method yields limit cycle solutions that are substantially improved over the Lagrangean grid model. This is due to the fact that the Lagrangean mesh sweeps through the ionization zones twice during one oscillation period, whereas the adaptive-mesh resolves them and tracks them continuously. The results are, in particular, smooth radial velocity and light curves. Beyond a physically better defined solution we also observe larger time steps for the convergence towards the limit cycle and for the evolution during one period. 12 refs., 13 figs., 5 tabs.

**35169** (UCRL-JC–108046) **Radiation-driven evolution of low-mass x-ray binaries and the formation of millisecond pulsars.** Tavani, M. (Lawrence Livermore National Lab., CA (United States)). Lawrence Livermore National Lab., CA (United States). 8 Aug 1991. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9101113–1: X-ray binaries and the formation of binary and millisecond radio pulsars, Santa Barbara, CA (United States), 21-25 Jan 1991). Order Number DE92000123. Source: OSTI; NTIS; INIS; GPO Dep.

Recent data on low-mass X-ray binaries (LMXBs) and millisecond pulsars (MSPs) pose a challenge to evolutionary theories which neglect the effects of disk and comparison irradiation. Here we discuss the main features of a radiation-driven (RD) evolutionary model that may be applicable to several LMXBs. According to this model, radiation from the accreting compact star in LMXBs "vaporizes" the accretion disk and the companion star by driving a self-sustained mass loss until a sudden accretion-turn off occurs. The main characteristics of the RD-evolution are: (1) lifetime of RD-LMXB's is of order $10^7$ years or less; (2) both the orbital period gap and the X-ray luminosity may be consequences of RD-evolution of LMXB's containing lower main sequence and degeneration companion stars; (3) the companion star may transfer mass to the primary even if it underfills its Roche lobe; (4) a class of recycled MSPs can continue to vaporize the low-mass companions by a strong pulsar wind even after the accretion turn-off; (5) the RD-evolutionary model resolves the apparent statistical descrepancy between the number of MSPs and their LMXB

progenitors in the Galaxy. We discuss the implications of the discovery of single MSPs in low-density globular clusters and the recent measurements of short orbital timescales of four LMXBs. 34 refs., 3 figs., 2 tabs.

## 6403 Atomic, Molecular, and Chemical Physics

*Refer also to citation(s) 34575, 34589, 34730, 34843, 34844, 35229, 35256, 35310, 35313, 35411, 35500, 35529*

**35170** (ANL/CP–73037) **Control of electron transfer rates by motions of atoms and molecules.** Miller, J.R. Argonne National Lab., IL (United States). [1990]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9009427–1: Conference on photochemical processes in organized molecular systems, Yokohama (Japan), 22-24 Sep 1990). Order Number DE91018575. Source: OSTI; NTIS; INIS; GPO Dep.

Recently measurements have been made of the temperature dependence of long distance intramolecular electron transfer reactions in molecules in which donor and acceptor groups are held at a fixed distance apart. For very highly exoergic electron transfer reactions, the rates show a remarkable independence of temperature. This temperature independence can be predicted quite precisely from the results of previous experiments which measured only the dependence of rates on free energy change. The temperature dependence can be ascribed to "nuclear tunneling" in high frequency vibrational modes which are coupled to the electron transfer reaction. While this is not surprising, the dominance of even a small coupling to high frequency modes in determining the temperature dependence is surprising. The importance of the high frequency modes is likely to be apparent in other contexts, particularly cases in which "dynamic solvent" effects occur for electron transfer reactions in highly viscous media. 63 refs., 6 figs.

**35171** (CONF-9108105–1) **Progress in collisions of multiply charged ions.** Phaneuf, R.A. Oak Ridge National Lab., TN (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 8. topical conference on atomic processes in plasmas; Portland, ME (United States); 25-29 Aug 1991. Order Number DE92000735. Source: OSTI; NTIS; INIS; GPO Dep.

The increasing power and availability of supercomputers during the last decade led to significant progress in the theory of multicharged ion interactions. However, important tests of many theoretical predictions were lacking, and have become possible only quite recently as new capabilities have been realized in the laboratory. This paper broadly surveys some of these experimental developments, and their impact on our understanding of collisional interactions of multicharged ions. The scope is limited to measurements made with monoenergetic beams. 35 refs., 6 figs.

**35172** (KFK–4802) **Laserspectroscopic investigations of isotope shifts and hyperfine structure of polonium isotopes.** Kowalewska, D. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Kernphysik. Jun 1991. 98p. Order Number DE92711541. Source: OSTI; NTIS (US Sales Only); INIS.

The isotope shifts and hyperfine structure have been measured for a series of polonium isotopes ($^{200}$Po, $^{202}$Po and $^{204}$Po to $^{210}$Po) by laser induced fluorescence on an atomic beam. The optical transition chosen for the investigations was the E1 transition $6p^4\ ^3P_2 \rightarrow 6p^3 7s\ ^5S_2$ with the longest possible wavelength $\lambda$=255.8 nm. In order to induce this UV transition, laser intracavity frequency doubling was applied. For that purpose a commercial ring dye laser system has been considerably modified, in particular the frequency selection scheme has been changed; the rebuilt laser system, as used in this work, is described. The measurements of the hyperfine structure led to the first determination of the nuclear magnetic dipole moment of $^{209}$Po. From the measured isotope shifts relative changes of the nuclear mean square charge radii $\delta\langle r^2\rangle$ have been estimated. Applying a calibration based on a nuclear model, absolute $\delta\langle r^2\rangle$ values have been determined. The observed features are discussed in terms of theoretical predictions and compared with experimental data for neighboring elements. (orig.).

**35173** (NIFS-PROC–5, pp. 69-77) **Reduction of low energy components in pulse ion beam.** Sato, M. (Himeji Inst. of Tech., Hyogo (Japan)); Hashimoto, Y.; Yatsuzuka, M.; Nobuhara, S. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185–: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications*. 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

We tried reduction of low energy components in pulse ion beams with self-crowbar switch of which operation was achieved by expansion of electrode plasmas in a small MITL. The experiments were carried out with the small MITL (self-crowbar switch) and the 'Inverse Pinch Ion Diode'. From the experimental results, the times required for dropping of pulse high voltage were shortened from 40 to 15 ns. As the result of this shortening, the ions accelerated at a relatively low voltage decreased, and the energy ranges of proton beams were reduced from 60 to 30 keV. (author).

**35174** (UCRL-LR–107714) **Realistic electronic structure calculations of magnetic insulators like $La_2CuO_4$.** Grant, J.B. Lawrence Livermore National Lab., CA (United States). Jul 1991. 112p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018653. Source: OSTI; NTIS; GPO Dep.

Thesis. Submitted to University of California, Davis.

One of the most striking discoveries of the past decade in materials science is the class of cuprate superconductors with high transition temperatures ($T_c$). In spite of the considerable success in identifying new cuprate superconductors, little is known of the fundamental interactions responsible for the phenomenon. There are two distinct features of these materials as a group, which might offer clues. First, they exhibit a large oxygen polarizability suggesting a strong electron-phonon interaction. It was this feature that led Bednorz and Mueller to focus on copper oxides as possible superconductors, and it is the electron-phonon interaction that is the essential component of the Bardeen-Cooper-Schriefer (BCS) theory of conventional superconductivity. Until recently, the small isotope effects measured (and references therein) have cast doubt on this explanation of superconductivity in these cuprates. While recent tunneling and neutron scattering measurements have revived the possibility of an electron-phonon explanation, they can not account for the high $T_c$ alone. The second distinct feature of these cuprates is that they are doped Mott-Hubbard insulators. The origin of the insulating behavior in undoped materials of this class has never been fully understood. Getting superconductivity, and moreover high temperature superconductivity, by doping such materials is equally mysterious, and has led many to suspect that a single physical principle is responsible for both unusual properties observed in this class of materials. The present thesis focuses on this Mott-Hubbard connection, and specifically on the electronic structure of such materials. Regardless of the pairing mechanism, a proper understanding of the electronic structure of these materials is essential to the identification of the carriers that will be involved in the pairing. 100 refs., 30 figs., 21 tabs.

## 6404 Fluid Physics

*Refer also to citation(s) 33656, 33728, 33963, 34825, 34831, 35017, 35376, 35453, 35500*

**35175** (ANL–90/51) **Local interfacial area concentration measurement in bubbly flow.** Ishii, M. (Argonne National Lab., IL (United States)); Revankar, S.T. Argonne National Lab., IL (United States). Oct 1990. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE91018702. Source: OSTI; NTIS; GPO Dep.

The interfacial area concentration is one of the most important parameters in a thermal-hydraulic analysis of two-phase flow systems based on the two-fluid model. A theoretical foundation of the measurement method for the time averaged local interfacial area using a double sensor probe is presented. Based on this theory, the double sensor resistivity probe was employed for the measurement of local properties of two-phase flow such as the interfacial velocity, local interfacial area concentration and void fraction in vertical air-water bubbly flow. Experimental data are presented on the radial profiles of the void fraction, bubble velocity, bubble chord length

and interfacial area concentration at various gas flow rates. In addition to these, some statistical information on turbulent motions of bubbles are presented. Each of the double sensors are checked against the global void measurement using a differential pressure. The result is very satisfactory. Furthermore, the area averaged void fraction, and the interfacial area concentration obtained from the double sensor probe measurement compared very well with the photographic measurements. The results show that the double sensor probe method is accurate and reliable for the local measurements of interfacial area and void fraction in bubbly two-phase flow. Results of the measurement of interfacial area concentration with the double sensor probe in forced flow loop are presented for bubbly flow at different liquid flow rates. The data indicate that the radial profiles of the interfacial area concentration show similar dependence on the liquid and gas flow rate like radial profiles of void fraction in the bubbly flow regime. 38 refs., 62 figs., 2 tabs.

**35176** (DOE/ER/13764–9) **Local phase distribution and interfacial area in a horizontal bubbly two-phase flow.** Kocamustafaogullari, G.; Huang, W.D.; Wang, Z. Wisconsin Univ., Milwaukee, WI (United States). Dept. of Mechanical Engineering. [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER13764. (CONF-9109267–1: International conference on multiphase flows, Tsukuba (Japan), 24-27 Sep 1991). Order Number DE92000079. Source: OSTI; NTIS; GPO Dep.

Short communication. SURFACE AREA; VOID FRACTION; PIPES/two-phase flow; HYDRODYNAMICS; FLUID MECHANICS; INTERFACES; BUBBLES; ENERGY TRANSFER; MASS TRANSFER; MOMENTUM TRANSFER; FLOW MODELS; AIR; WATER; GAS FLOW; PIPES

**35177** (DOE/ER/25053–6) **[Analytical and computational mathematical physics: Progress report, January 1, 1991–December 31, 1991].** New York Univ., NY (United States). Courant Inst. of Mathematical Sciences. [1991]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER25053. Order Number DE91018965. Source: OSTI; NTIS; GPO Dep.

This report briefly discusses research on computational methods for gas dynamics and solidification, and mesh generating techniques. (LSP)

**35178** (DOE/ER/25084–2) **The modeling of complex continua: Fundamental obstacles and grand challenges: Progress report.** State Univ. of New York, Albany, NY (United States). Research Foundation. Sep 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER25084. Order Number DE91018806. Source: OSTI; NTIS; GPO Dep.

The focus of this research program is to achieve quantitatively correct computations in the modeling of complex continua. The central theme of the effort is to continue the development of a coherent approach that is independent of any one particular application. This is done by absracting important mathematical concepts and computational methods from individual applications which generalize to all applications involving complex continua. The generic difficulties in the modeling of continua that guide this abstraction are associated with (a) multiple length and time scales, often involving sharply defined internal layers of boundaries, (b) high dimensional descriptions of the solution variables, (c) microstructures such as droplets, vortices and crystal defects, and (d) chaotic or random phenomena described by a statistical formulation. The scientific goal is achieved by identifying critical research areas and, within them, focusing the development of the theory necessary to support computation. The mathematical concepts and computational methods thus developed are generalized where possible and added to an integrated framework for general use in complex continua problems.

**35179** (EGG-M–91257) **Self-consistent modeling of plasma spraying processes.** Chang, C.H.; Ramshaw, J.D. EG and G Idaho, Inc., Idaho Falls, ID (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. (CONF-910867–1: 10. international symposium on plasma chemistry, Jerusalem (Israel), 4-9 Aug 1991). Order Number DE91018820. Source: OSTI; NTIS; INIS; GPO Dep.

A new numerical model is described for simulating thermal plasmas containing entrained particles, with emphasis on plasma spraying applications. The plasma is represented as a continuum multicomponent chemically reacting ideal gas, while the particles are tracked as discrete Lagrangian entities coupled to the plasma. Computational results are presented from a transient simulation of the melting of alumina particles injected into an axisymmetric pure argon plasma jet. 13 refs., 5 figs.

**35180** (LBL–31200) **Capillary surfaces in exotic containers.** Concus, P. (Lawrence Berkeley Lab., CA (United States)); Finn, R. Lawrence Berkeley Lab., CA (United States). Jul 1991. 4p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-910786–1: International symposium on hydromechanics and heat/mass transfer in microgravity, Kama River (USSR), 6-11 Jul 1991). Order Number DE92000956. Source: OSTI; NTIS; GPO Dep.

A survey is presented of results to date for capillary surfaces in "exotic" containers. These containers have the property that each one admits a continuum of distinct equilibrium free surfaces, all bounding with the container walls the same volume of fluid, making the same contact angle at the trip interface curve, and having identical mechanical energies. The containers can be so designed that they are themselves axially symmetric but that the fluid configurations of minimizing energy cannot be axially symmetric. 9 refs., 2 figs.

**35181** (PNL-SA–19765) **Properties of liquid water and carbon dioxide from constant temperature-constant temperature molecular dynamics.** Palmer, B.J. Pacific Northwest Lab., Richland, WA (United States). Aug 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9108164–1: Chemistry and physics of liquids conference, Plymouth, NH (United States), 12-16 Aug 1991). Order Number DE91018219. Source: OSTI; NTIS; GPO Dep.

Although most experimentalists control experimental conditions by fixing the temperature and pressure, most molecular dynamics (MD) simulations of complicated systems are done by fixing the volume and energy. The energy is easily determined by scaling the atomic velocities to give the desired temperature, but the volume is another matter. Determining the correct volume corresponding to a particular pressure using a series of constant energy simulations is at best a tedious business. It is further complicated by the enormous pressure fluctuations that are present in a system the size of most MD simulations. Fortunately, recent advances in MD simulation techniques, primarily by Andersen and Nose, promise to simplify this process considerably. Constant pressure-constant temperature molecular dynamics (NPTMD) simulations can be used to prepare systems at a previously specified temperature and pressure in a single simulation. A great deal of equilibrium information can also be obtained at the same time, as well as some dynamical quantities. The use of NPTMD in modeling molecular fluids is investigated by looking at several models of water and carbon dioxide. 17 refs., 4 figs., 3 tabs.

**35182** (UCRL-CR–107853) **Microchannel cooling with subcooled boiling: Executive summary of first year's results: Final report No. 1.** Hoffman, M.A. California Univ., Davis, CA (United States). Sep 1990. 96p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91019009. Source: OSTI; NTIS; GPO Dep.

During the first year's effort, we started with we felt to be the most critical problem: namely, the prediction of the point of bubble departure, BD (also referred to as the point of onset of significant net vapor generation, OSNVG). Mr. Stetson started work on the project in January 1990, when the funding was officially received, and spend some time becoming acquainted with the SCB-1A code. Then he examined the models of Saha & Zuber, Levy and Staub for the location of the BD point and the models of Rohani, Levy and Staub for the size of the bubble at the BD point. (1) At the present time, the best model to use to predict the ONSVG point for sub-millimeter diameter tubes appears to be the Saha-Zuber correlation. Data in channels with hydraulic diameters from about 24 mm down to about 1 mm agree with the correlation to within about

±25%. (2) It is not at all clear which is the best correlation to use to predict the average bubble diameter at the OSNVG point in sub-millimeter diameter tubes. We have decided to retain the modified Rouhani correlation in the code for the time being, recognizing that it is probably inadequate. We will also compare predictions of the heat transfer performance in small sub-millimeter diameter tubes using the bubble departure diameters from the modified Rouhani correlation to those using modified Staub model. 16 refs., 24 figs.

**35183** (VTT-TIED–1207) **Magnetic fluids and their applications.** Saeynaetjoki, M. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Konepajan Tuotantotekniikan Lab.). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1991. 31p. (In Finnish). Order Number DE92704012. Source: OSTI; NTIS (US Sales Only).

Magnetic fluids consist of carrier fluid, magnetically active particles and surfactant on each particle preventing the agglomeration of the particles. The fluids acting in the presence of the magnetic field like the ferromagnetic materials but remaining their fluid properties are prepared in this way. Potential applications of these fluids are magnetic separation, ink jet printing, sealing, damping, lubrication and heat transfer. So far, the industrial applications of the magnetic fluids are in the seals and bearings of the computer hard disk drives, in the heat transfer and damping of loudspeakers and in the damping of step motors. The other applications are in laboratory and research stage.

## 6450 High Energy Physics

*Refer also to citation(s) 35260*

**35184** (DOE/ER/40213–8) **Theory and phenomenology of strong and weak interaction high energy physics (Task A): Progress report, [March 1, 1991–January 31, 1992].** Carruthers, P.; Thews, R.L. Arizona Univ., Tucson, AZ (United States). Dept. of Physics. 1 Aug 1991. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER40213. Order Number DE91017853. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses research being conducted at the University of Arizona on the theory and phenomenology of strong and weak interaction high energy physics. (LSP)

**35185** (KFK–4841) **Report on research and development results in 1990 by the Institute for Nuclear Physics.** Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Kernphysik. Mar 1991. 18p. (In German). Order Number DE92714354. Source: OSTI; NTIS (US Sales Only); INIS.

Part I and III of the Institute of Nuclear Physics mainly work in different fields of nuclear and elementary particle physics, with problems bordering astrophysics being in the foreground. A joint research project of the two sections consists in studying cosmic radiation in the energy range above $10^{14}$ eV by means of large-scale detector systems on the earth's surface. The composition of primary radiation, the existence of point sources of high-energy radiation, and their position in space are questions of priority interest. (orig./HP).

## 6451 Particle Interactions and Properties - Experimental

*Refer also to citation(s) 34934, 35245, 35246, 35247, 35248, 35249, 35250, 35252, 35253, 35270, 35278, 35284, 35285, 35372*

**35186** (ANL-HEP-CP–90-122) **First results from the Soudan 2 proton decay experiment.** Litchfield, P.J. Soudan 2 collaboration. Argonne National Lab., IL (United States). High Energy Physics Div. 21 Nov 1990. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9010128–5: 14. Europhysics conference on nuclear physics: rare nuclear decays and fundamental processes, Bratislava (Czechoslovakia), 22-26 Oct 1990). Order Number DE91018596. Source: OSTI; NTIS; INIS; GPO Dep.

Soudan 2 is a 1000 ton iron drift calorimeter designed to search for proton decay with a sensitivity to the lifetime divided by branching fraction of up to $5 \times 10^{32}$ years in all detectable decay modes. Current experiments have already yielded limits at this level in distinctive, all charged, two body modes such as $e^+\pi^0$. However in many modes containing a neutrino or having a high multiplicity the limits are an order of magnitude or more lower because their selections are saturated by background produced by atmospheric neutrino interactions. Soudan 2 collects much more information per event than previous experiments. This allows a better discrimination against background, enabling essentially background free samples of all modes to be defined at the above sensitivity. Soudan 2 began operations in mid-1988 when 275 tons of detector was installed. Currently 580 tons is operational and it is expected that the full 1000 ton detector will be completed in 1992. During the installation work the detector has operated for physics at about 60% overall efficiency. This early data has enabled us to develop software and analysis procedures which are now in routine use to collect contained events. As of mid September 1990 Soudan 2 had an integrated total exposure of 0.36 kton-years of which 0.29 kton-years was within a fiducial volume defined by 20cm cuts around the edge of the detector and 50cms in the drift direction. Physics topics being studied include: (a) Contained interactions for the study of proton decay and atmospheric neutrino oscillations. (b) Single muons in search for astronomical point sources of cosmic rays. (c) A search for magnetic monopoles passing through the detector. (d) Multiple muons in coincidence with a surface detector of atmospheric showers to study the composition and origin of cosmic rays. Since this a rare decay conference, this paper will concentrate on the contained event data.

**35187** (ANL-HEP-CP–91-76) **Identifying the origin of new gauge bosons at the SSC and LHC.** Hewett, J.L. (Argonne National Lab., IL (United States)); Rizzo, T.G. Argonne National Lab., IL (United States). Aug 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;W-7405-ENG-82. (CONF-910881–11: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000290. Source: OSTI; NTIS; INIS; GPO Dep.

The ability of an SCD-like detector to identify the origin of a new neutral gauge boson $Z_2$, once it has been discovered at the SSC and/or LHC, is examined. 9 refs., 3 figs.

**35188** (ANL-HEP-TR–91-70) **B-jet tagging using electrons at SDC.** Wicklund, A.B. Argonne National Lab., IL (United States). 14 Aug 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (SDC–91-00051). Order Number DE91018547. Source: OSTI; NTIS; INIS; GPO Dep.

This note examines b-jet tagging at SDC, using semileptonic b $\rightarrow e\nu$ X electron decays. The main application for this tagging capability would be in the study of Top decays. Thus, we consider Top decays in a "reasonable" mass range (e.g. 110 < Mtop < 170). For completeness, we also consider inclusive QCD production of b-quarks. We are mainly interested in the effects of hadron calorimeter segmentation on the electron efficiency, assuming that similar algorithms are used for electron ID at SDC as at CDF. We review the following topics: kinematics of top decay; kinematics of semileptonic b-decay; effects of Had/EM cuts on electron ID, as a function of b-decay kinematics and calorimeter segmentation; overall efficiency for b-tagging from Top decay and inclusive b-production. We consider only the barrel region in our simulation, e.g. $\eta < 1.4$. 19 figs.

**35189** (ANL-HEP-TR–91-74) **$Z^0 \rightarrow$ hadrons in SDC.** Wicklund, A.B. Argonne National Lab., IL (United States). 30 Aug 1991. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (SDC–91-00081). Order Number DE92000294. Source: OSTI; NTIS; INIS; GPO Dep.

We report on a study of hadronic $Z^0$ decays at high $P_t(P_t>500$ GeV/c), at 40 TeV CM energy. Our goal here is to understand the effects of the kinematics of $Z^0$ decay, especially the Lorentz boost, on detection issues. We used an ISAJET sample of Drell Yan events, requiring the $Z^0$ to have pseudorapidity ($\eta$) in [-1.5,1.5] and $P_t>500$ GeV/c. ISAJET forces the $Z^0$ to decay to two primary partons, which then cascade by gluon and quark emission to stable hadrons. We excluded $Z^0 \rightarrow \nu\bar{\nu}$ decays. In about 10% of the hadronic decays, significant energy is lost due to neutrino emission from heavy quarks, so that the hadronic mass is significantly less

than the $Z^0$ mass generated; these events were not explicitly removed. We treated muons like other hadrons, assuming that high $P_t$ muons could be identified and corrected for. For this study we retained only the stable daughter particles in $Z^0$ decay, labelled according to their parton parentage ("Jet 1 or 2"). We ignored the particles from the underlying event and from other final state jets. (These contributions, along with other non-$Z^0$ "noise", can be explicitly added back for relevant studies.) Finally, we note that the $Z^0$ decay angular distribution is approximately flat for these events, not peaked at 90 deg. as in Higgs $\rightarrow Z^0Z^0$; this will have little effect on our conclusions. To avoid very asymmetric decays, we required each of the two jets to satisfy $P_t > 100$ GeV/c.

**35190** (ANL-HEP-TR-91-78) **Effects of shower spreading on $Z^0 \rightarrow$ J J mass resolution.** Wicklund, A.B. Argonne National Lab., IL (United States). 4 Sep 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (SDC-91-00083). Order Number DE92000296. Source: OSTI; NTIS; INIS; GPO Dep.

This study concerns the effects of hadronic shower spreading and lateral calorimeter segmentation on the jet-jet mass resolution, for high Pt (Pt>500 GeV) hadronic $Z^0$ decays. In a previous study, we examined the effects of lateral calorimeter segmentation on detection and measurement of high Pt $Z^0 \rightarrow$ jet-jet, for an ideal calorimeter with no lateral shower spreading. Other recent studies have also examined the dependence of $Z^0$ mass resolution on calorimeter segmentation, using more realistic models of shower spreading. The studies reported so far have assumed a common calorimeter segmentation for the EM and HAD compartments, and have concluded that (.05×.05) segmentation is a desirable optimization point, given the basic limitations imposed by calorimeter energy resolution, shower size, underlying event, etc. In the present study, we consider the case that HAD is segmented more coarsely, specifically (.1×.1) instead of (.05×.05), and we assume that the EM segmentation is fixed at (.05×.05), as driven by electron identification requirements. This "hybrid segmentation" would represent a significant cost saving for SDC. We might expect that the effects of coarser HAD segmentation on the jet- jet mass resolution would be minimal for two reasons. First, roughly half the jet energy is deposited in the EM compartment anyway, and benefits from the (.05×.05) EM cell size. Second, the lateral hadron shower size increases with depth, so that the shower spreading is larger on average in the HAD calorimeter alone, than it is in EM + HAD combined. Thus we might expect coarser segmentation to be less important deeper in the calorimeter.

**35191** (BNL-46214) **A search for the coherent production of axions in the milli eV range.** Cameron, R. (Rochester Univ., NY (United States)); Melissinos, A.C.; Semertzidis, Y.; Cantatore, G.; Rizzo, C.; Ruoso, P.; Zavattini, E.; Halama, H.; Lazarus, D.M.; Prodell, A.; Nezrick, F. Brookhaven National Lab., Upton, NY (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH00016 ;AC02-76ER03075. Grant PHYS-861 3003. (CONF-910881-16: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000439. Source: OSTI; NTIS; INIS; GPO Dep.

Axions provide a natural explanation for the absence of CP violation in the strong interaction. As weakly interacting light particles they are also candidates for the much sought after dark matter allegedly responsible for our lack of understanding of galactic dynamics. Beam dump, particle decay and astrophysical measurements carried out over the past decade have failed to provide positive evidence for their existence over a wide range of masses and coupling strengths. This experiment attempts to produce and detect scalar and pseudoscalar particles coherently produced through the interaction of laser photons with the virtual photons of the magnetic fields of superconducting dipole magnets as manifested by small changes in the polarization state of the laser light. A limit on the coupling of the axion to 2 photons of $g_{a\gamma\gamma} < 6.67 \times 10^{-7}$ GeV$^{-1}$ was achieved. 8 refs., 3 figs.

**35192** (BNL-46517) **Rare $K^+$ decays in flight: Latest results and future plans.** Alliegro, C. (Yale Univ., New Haven, CT (United States)); Zeller, M.E.; Campagnari, C.; Chaloupka, V.; Lubatti, H.J.; Zhao, T.; Cooper, P.S.; Egger, J.; Herold, W.D.; Kaspar, H.; Gordon, H.A.; Lazarus, D.M.; Rehak, R.; Hadley, N.J. Brookhaven National Lab., Upton, NY (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC02-76CH00016 ;AC02-76ER03075. Grant PHY-8613003. (CONF-910881-13: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000484. Source: OSTI; NTIS; INIS; GPO Dep.

E777 at the Brookhaven AGS has published a final branching ratio limit for the lepton family violating decay $K^+ \rightarrow \pi^+\mu^+e^-$ of 2.1 × $10^{-10}$ (90% C.L.). New results based on approximately 500 events of the G.I. M. suppressed decay $K^+ \rightarrow \pi^+e^+e^-$ have yielded a branching ratio of (2.75 ± 0.23 ± 0.13) × $10^{-7}$ assuming a vector interaction with, a form factor = 0.105 ± 0.035 ± 0.015. The branching ratio times decay probability for $K^0 \rightarrow \pi^+ X^0$, $^0 \rightarrow e^+e^-$ was found to less than 1.5 × $10^{-8}$ (99% C.L.) in the $e^+e^-$ invariant mass range of 150 to 340 MeV/c. An approved second generation experiment sensitive to $K^+ \rightarrow \mu^+e^-$ at the $10^{-12}$ level is discussed. 5 refs., 3 figs.

**35193** (BNL-46546) **Particle production and spectra in E802 at BNL-AGS.** Videbaek, F. The E802 Collaboration. Brookhaven National Lab., Upton, NY (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9106274-1: Symposium on high energy nuclear collisions and quark gluon plasma, Kyoto (Japan), 6-8 Jun 1991). Order Number DE91018729. Source: OSTI; NTIS; INIS; GPO Dep.

The production of $\pi$, K, and protons measured in the E802 spectrometer are studied for p+A and Si+A collisions. Systematic properties of particle spectra and rapidity density distributions are discussed in terms of centrality and reaction system. A detailed comparison of the data to the RQMD model, which employs the experimental acceptance and cuts are presented. 8 refs., 6 figs.

**35194** (BNL-46555) **An experiment to observe strange particle production in ion collisions at the AGS.** Eisemen, S.E. (Brookhaven National Lab., Upton, NY (United States)); Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; Lindenbaum, S.R.; Chan, C.S.; Kramer, M.A.; Zhao, K.; Hallman, T.J.; MadanBrookhaven National Lab., Upton, NY (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016 ;AC02-83ER40107 ;AS05-81ER40032 ;AC02-76ER03274. (CONF-9106274-2: Symposium on high energy nuclear collisions and quark gluon plasma, Kyoto (Japan), 6-8 Jun 1991). Order Number DE92000135. Source: OSTI; NTIS; INIS; GPO Dep.

We present the results of a measurement of neutral vee production with 14.6 × A GeV/c Si beams on Au and Cu targets. The $\Lambda$ and $K_s^0$ yields were measured as a function of negative particle multiplicity. Effective temperatures were determined from an exponential fit to the transverse mass distribution. 6 refs., 8 figs., 1 tab.

**35195** (BNL-46579) **B-Physics.** Soni, A. Brookhaven National Lab., Upton, NY (United States). [1991]. 24p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9101105-2: Workshop on high energy physics phenomenology, Calcutta (India), Jan 1991). Order Number DE92000477. Source: OSTI; NTIS; INIS; GPO Dep.

Rare B decays, measurement of CKM angles, Zweig rule violating decays of the $\gamma$(4S) and CP and violation are briefly discussed. After a brief overview I cover the following topics: rare i.e. Loop Decays; determination of KM angles; Zweig-rule violating decays of the $\gamma$(4S); CP violation; and outlook.

**35196** (DESY-91-051) **Measurement of the direct photon spectrum from Υ(1S) decays.** Bizzeti, A. (Istituto Nazionale di Fisica Nucleare, Florence (Italy)); Cartacci, A.; Compagnucci, A.; Conforto, G.; Landi, G.; Monteleoni, B.; Pelfer, P.G.; Schuette, J.; Folger, G.; Glaser, G.; Kobel, M.; Lurz, B.; Volland, U.; Wegener, H.; Antreasyan, D.Crystal Ball Collaboration. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 15p. Contract DE-AC02-76ER03066;BMFT

054ER12P;BMFT 054HH11P(7);DE-AC0 (SLAC-PUB–5400). Order Number DE92714438. Source: OSTI; NTIS (US Sales Only); INIS.

Using the Crystal Ball detector at the $e^+e^-$ storage ring DORIS II, we have measured the energy spectrum of direct photons from $\Upsilon$(1S) decays. According to QCD, these photons result from the decays for the $\Upsilon$(1S) resonance into one photon and two gluons, $\Upsilon(1S)\rightarrow\gamma gg\rightarrow\gamma+$hadrons. The shape of our spectrum does not agree with that calculated in lowest order QCD, but can be described well by a prediction incorporating gluon self-interaction. Using this fit, the ratio $R_\gamma=\Gamma(\Upsilon\rightarrow\gamma gg)/\Gamma(\Upsilon\rightarrow ggg)$ is determined to be $(2.7\pm0.2\pm0.4)\%$. From this ratio we deduce the strong coupling constant in the anti Manti S scheme at $Q^2$=2.2 GeV$^2$ and find $\alpha_s=0.25\pm0.02\pm0.04$. (orig.).

**35197** (DESY–91-055) **Observations of $\Lambda_c^+$ semileptonic decay.** Albrecht, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Ehrlichmann, H.; Hamacher, T.; Krueger, A.; Nau, A.; Nippe, A.; Reidenbach, M.; Schaefer, M.; Schroeder, H.; Schulz, H.D.; Sefkow, F.; Wurth, R.; Appuhn, R.D.; Hast, C.; HerreARGUS Collaboration. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 14p. Contract BMFT 054DO51P;BMFT 054ER12P;BMFT 055HD21P;BMFT 054KA17P Order Number DE92714436. Source: OSTI; NTIS (US Sales Only); INIS.

Direct observations of the semileptonic decay of $\Lambda_c^+$ in the decay channels $\Lambda_c^+\rightarrow\Lambda e^+X$ and $\Lambda_c^+\rightarrow\Lambda\mu^+X$ have been made using the ARGUS detector at the DORIS II $e^+e^-$ storage ring. The cross section times branching ratio were found to be, $\sigma(e^+e^-\rightarrow\Lambda_c^+X).BR(\Lambda_c^+\rightarrow\Lambda e^+X)=4.20\pm1.28\pm0.71$ pb and $\sigma(e^+e^-\rightarrow\Lambda_c^+X).BR(\Lambda_c^+\rightarrow\Lambda\mu^+X)=3.91\pm2.02\pm0.90$ pb. (orig.).

**35198** (DESY–91-056) **A measurement of $\tau(B^+)/\tau(B^0)$ from the lepton and dilepton rates in $\Upsilon$(4S) decays.** Albrecht, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Ehrlichmann, H.; Hamacher, T.; Krueger, A.; Nau, A.; Nippe, A.; Reidenbach, M.; Schaefer, M.; Schroeder, H.; Schulz, H.D.; Sefkow, F.; Wurth, R.; Appuhn, R.D.; Hast, C.; HerreARGUS Collaboration. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 10p. Contract BMFT 054DO51P;BMFT 054ER12P;BMFT 054HD24P;BMFT 054KA17P Order Number DE92714439. Source: OSTI; NTIS (US Sales Only); INIS.

Using the ARGUS detector at the $e^+e^-$ storage ring DORIS II, we have determined the lepton and dilepton rates in $\Upsilon$(4S) decays. From this measurement we derive the lifetime ratio of charged and neutral B mesons and obtain $\tau(B^+)/\tau(B^0)=1.00^{+0.49}_{-0.32}$. (orig.).

**35199** (DOE/ER/02504–656) **High energy accelerator and colliding beam user group: Progress report, March 1, 1991–February 29, 199.** Snow, G.A.; Skuja, A. Maryland Univ., College Park, MD (United States). Dept. of Physics and Astronomy. Aug 1991. 146p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76ER02504. Order Number DE91018531. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses work in the following areas: The Study of $e^+e^-$ Interactions; Calculation of Radiative Polarization Effects in Electron Storage Rings; Hadron Collider Physics; Fixed Target Physics and Particle Physics of General Interest; and The Solenoidal Dectector Collaboration at the SSCL.

**35200** (FNAL/C–91/216) **Measurement of $\bar{p}p$ elastic scattering parameters at $\sqrt{s}$ = 1.8 TeV.** Shukla, S. E710 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Aug 1991. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9105241–2: 4. international conference on elastic and diffractive scattering, Isola D'Elba (Italy), 22-25 May 1991). Order Number DE91018960. Source: OSTI; NTIS; INIS; GPO Dep.

A measurement of the total nuclear cross section, $\sigma_t$, the ratio of the real to the imaginary part of the forward nuclear elastic scattering amplitude, $\rho$, and the nuclear slope parameter, B, for $\bar{p}p$ elastic scattering at $\sqrt{S}$ = 1.8 Te V, is presented. We find $\sigma_t$ = 72.8 $\pm$ 3.1 mb, $\rho$ = 0.140 $\pm$ 0.69 and B = 16.99 $\pm$.47 (GeV/c)$^{-2}$. 5 refs., 13 figs., 2 tabs.

**35201** (FNAL/C–91/223-E) **Results from $\bar{p}p$ colliders.** Huth, J. Fermi National Accelerator Lab., Batavia, IL (United States). Aug 1991. 30p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-910881–7: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000156. Source: OSTI; NTIS; INIS; GPO Dep.

Recent results $\bar{p}p$ colliders are presented. From elastic scattering experiments at the Tevatron, an average value of $\sigma_{tot}$ = 72.1$\pm$2 mb is reported, along with a new measurement of $\rho$ = 0.13 $\pm$ 0.7. New measurements of jet direct photon and high $p_t$ W and Z production are compared to more precise, higher order predictions from perturbative QCD. Recently available data on the W mass and width give combined values for $M_W$ = 80.14$\pm$0.27 GeV/c$^2$, and $\Gamma$(W) =2. 14 $\pm$ 0.08 GeV. From electroweak radiative corrections and $M_W$, one finds $M_{top}$ = 130$\pm$40 GeV/c$^2$, with a 95% C.L. upper limit at 210 GeV/c$^2$. Current limits on $M_{top}$ are presented, along with a review of the prospects for top discovery. From jet data there is no evidence of quark substructure down to the distance scale of 1.4 $\times$ $10^{-17}$ cm, nor is there evidence for supersymmetry or heavy gauge bosons at $\bar{p}p$ colliders, allowing lower limits on $M_W$, > 520 GeV/c$^2$ and $M_Z$ 412 GeV/c$^2$. 66 refs., 26 figs.

**35202** (FNAL/C–91/227) **Measurement of $\rho$, the ratio of the real to imaginary part of the $\bar{p}p$ forward elastic scattering amplitude, at $\sqrt{s}$ = 1.8 TeV.** Rubinstein, R. Fermi National Accelerator Lab., Batavia, IL (United States). Aug 1991. 3p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States); North Atlantic Treaty Organization, Brussels (Belgium); Ministry of Public Instruction (Italy). DOE Contract AC02-76CH03000. (CONF-910881–9: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000155. Source: OSTI; NTIS; INIS; GPO Dep.

We have measured $\rho$, the ratio of the real to the imaginary part of $\bar{p}p$ forward elastic scattering amplitude, at $\sqrt{s}$ = 1.8 TeV. Our result, $\rho$ = 0.140 $\pm$ 0.069, is consistent with the expected value, and thus no new physics is required. 10 refs., 2 figs.

**35203** (FNAL/C–91/234-E) **Search for new particles in CDF.** Laasanen, A. (Purdue Univ., Lafayette, IN (United States). Dept. of Physics). The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-910881–17: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000638. Source: OSTI; NTIS; INIS; GPO Dep.

Preliminary results on searches for new particles beyond the Standard Model are presented. The data were taken by the CDF collaboration at the Fermilab $\bar{p}p$ collider at a center of mass energy of 1.8 TeV. Limits on the masses of the gluino and squark in a minimal supersymmetric theory are given. The 90% confidence level asymptotic lower mass limits on each are 150 GeV/c$^2$. A special data run was taken to search for the diffractively produced sextet quark state $\eta_6$. An $\eta_6$ with a mass larger than 20 GeV/c$^2$ is excluded at the 95% confidence level. Limits are also set on the pair-production of massive stable charged particles. Unit-charged particles belonging to spin $\frac{1}{2}$ color triplets with masses between 50 and 139 GeV/c$^2$ are ruled out at the 95% confidence level as are charge 2/3 particles with masses between 50 and 116 GeV/c$^2$ and charge 4/3 particles with masses between 50 and 140 GeV/c$^2$. 5 refs., 3 figs.

**35204** (FNAL/C–91/236-E) **Isolated single and double direct photon production at CDF.** Harris, R. The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1991. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-910881–15: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000471. Source: OSTI; NTIS; INIS; GPO Dep.

We present measurements of isolated direct phonon production in $\bar{p}p$ collisions at $\sqrt{s}$ = 1.18 TeV from the 1988–89 run of the Collider Detection at Fermilab (CDF). Quantum Chromodynamics is tested against measurements of the transverse momentum spectrum of single photon production ($\bar{p}p\rightarrow\gamma+X$), double photon production ($\bar{p}p\rightarrow\gamma\gamma+X$), and the distribution of cos$\theta^*$ in photon-jet events ($\bar{p}p\rightarrow\gamma_J+X$). We also present a measurement of the isolated production ratio of $\eta$ and $\pi^0$ mesons ($\bar{p}p\rightarrow\eta+X$)/($\bar{p}p\rightarrow\pi^0+X$) = 1.02 $\pm$.15(stat)$\pm$.23(sys). 9 refs., 2 figs.

**35205** (FNAL/C–91/237-E) **Measurement of $B^0\bar{B}^0$ mixing at CDF.** Song, L. Fermi National Accelerator Lab., Batavia, IL (United States). Sep 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-910881–18: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000640. Source: OSTI; NTIS; INIS; GPO Dep.

Using dileptons ($e\mu$, ee) to tag B hadron decays, the average $B^0\bar{B}^0$ mixing parameter $\chi$ is measured in $p\bar{p}$ collisions at $\sqrt{s}$ = 1.8 TeV. From $e\mu$ channel, we obtain $\chi$ = 0.179 ± 0.027 (stat) ± 0.022 (sys) ± 0.032 (model), and from the ee channel, $\chi$ = 0.172 ± 0.060 (stat) ± 0.024 (sys) ± 0.026 (model), where the last uncertainty is due to Monte Carlo modeling. 14 refs., 2 tabs.

**35206** (FNAL/C–91/238-E) **T,b, and new particle searches at $p\bar{p}$ colliders.** Crane, D.A. Fermi National Accelerator Lab., Batavia, IL (United States). Aug 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-9106285–1: 11. international conference on physics in collision, Colmar (France), 20-22 Jun 1991). Order Number DE92000637. Source: OSTI; NTIS; INIS; GPO Dep.

Experiments at the $p\bar{p}$ colliders at CERN and FNAL have an active program of heavy flavor physics. Recently, CDF at FNAL and UA1 at CERN have measured rare decays of the $B^0 - \bar{B}^0$ mixing. CDF has signals for $B^{\pm} \rightarrow J/\psi K^{\pm}$ and $B^0 \rightarrow J/\psi K^{*0}$. Both CDF and UA1 have set limits on the branching ratio of $B^0 \rightarrow \mu^+\mu^-$ and have measured $B^0 - \bar{B}^0$ mixing. CDF, UA1 and UA2 at CERN have searched for the top quark and set limits on its mass. Prospects for t and b physics at FNAL in the near future are presented. 21 refs., 14 figs.

**35207** (KEK–90-22) **Proceedings of the 15th workshop on the mass of the electron neutrino.** Yasumi, Shinjiro (ed.) (Teikyo Univ., Tokyo (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Mar 1991. 43p. (In Japanese). (CONF-9101112–: 15. workshop on the mass of the electron neutrino, Tsukuba (Japan), 10 Jan 1991). Order Number DE92704307. Source: OSTI; NTIS (US Sales Only); INIS.

This booklet carries eight talks and three appendices presented at the 15th workshop on the mass of the electron neutrino held on January 10, 1991, at National Laboratory for High Energy Physics (or KEK), Japan. The workshop focuses on recent studies on $m\nu_e$, studies and comments on 5p-3s line of Dy atom, measurement of the number of incident photons in $m\nu_e$-PF experiments, measurement of absorption cross section of Dy atom for soft X-ray, evaluation of $\sigma_i{}^{\alpha}$ of Dy atom, $\lambda_N/\lambda_M$ experiments (synthesis of $Ho(fod)_3$, measurement with heated proportional counter), and monochromator for soft X-ray in the range of 1.0-1.6 keV. In particular, discussions for $m\nu_e$-PF experiments are made focusing on the development of a high-performance monochromator for soft X-ray in the range of 1.0-1.6 keV for measuring the fluorescent X-ray spectra of $S_{Ed}$, $S_{Ee}$ and $S_{Ef}$. It is still nuclear whether the deterioration in a beryl crystal monochromator is associated with temperature changes or radiation damage, but cooling equipment for tests under decreasing temperature is now being constructed at KEK. Performance tests of a heated proportional counter for non-active $Ho(fod)_3$ and the production of active $Ho(fod)_3$ are also planned to be conducted. (N.K.).

**35208** (LA-UR–91-2891) **Strangeness production at 200 GeV/Nucleon.** Jacak, B.V. For the HELIOS collaboration. Los Alamos National Lab., NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9106274–3: Symposium on high energy nuclear collisions and quark gluon plasma, Kyoto (Japan), 6-8 Jun 1991). Order Number DE92000259. Source: OSTI; NTIS; INIS; GPO Dep.

Results from the HELIOS External Spectrometer on kaon production in 200 GeV/A S+W and p+W collisions are presented. The $K/\pi$ ratios are compared with measurements at lower bombarding energies and are found to agree remarkably well. Evidence for secondary production of $K^+$ by meson-baryon rescattering is reviewed. The target rapidity results are compared with neutral strange particle results at midrapidity. 15 refs., 4 figs., 2 tabs.

**35209** (LA-UR–91-3136) **Direct measurements of neutrino mass: A status report.** Robertson, R.G.H. Los Alamos National Lab., NM (United States). [1991]. 22p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9103166–5: 2. international symposium on particles, strings and cosmology, Boston, MA (United States), 25-30 Mar 1991). Order Number DE92000168. Source: OSTI; NTIS; INIS; GPO Dep.

Some recent developments in the experimental search for neutrino mass are discussed. New data from Los Alamos on the electron neutrino mass as measured in tritium beta decay give an upper limit of 9.3 eV at the 95% confidence level. This result is not consistent with the long-standing ITEP result of 26(5) eV within a "model-independent" range of 17 to 40 eV. It now appears that the electron neutrino is not sufficiently massive to close the universe by itself. Hime and Jelley report finding new evidence for a 17-keV neutrino in the B decay of $^{35}S$ and $^{63}Ni$. Many other experiments are being reported and the situation is still unresolved. 56 refs., 1 fig., 3 tabs.

**35210** (LBL–30734) **Meson and baryon correlation studies using the PEP-TPC/2$\gamma$ Facility.** Ronan, M.T. Lawrence Berkeley Lab., CA (United States). Mar 1991. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9103200–2: 26. Rencontres de Moriond conference, Les Arcs (France), 10-24 Mar 1991). Order Number DE92000853. Source: OSTI; NTIS; INIS; GPO Dep.

Results on vector meson, and strange and charmed-baryon production are presented for data taken during the period 1982–1986 using the TPC/2$\gamma$ detector at PEP. Vector mesons ($\rho^0$, $K^*$ and $\phi$) with 0, 1 and 2 strange quarks are used to obtain redundant measures of strange-quark suppression and of the vector to pseudoscalar ratio in hadronization. Measurements of the production rates of $\Lambda$, $\Xi^-$, $\Omega$ and $\Xi^{*0}$ hyperons and for the $\Lambda_c$ and of rapidity correlations between $\Lambda\bar{\Lambda}$ pairs provide sensitive tests of baryon production in fragmentation models. In addition, two- and three-particle correlations between like sign pions provide further evidence for the Bose-Einstein effect in $e^+e^-$ interactions including the relativistic motion of particle sources. 9 refs., 7 figs.

**35211** (LBL–30849) **Mini-jet and particle production in ultra-relativistic heavy ion collisions.** Wang, Xin-Nian. Lawrence Berkeley Lab., CA (United States). Jul 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (CONF-9105106–29: Conference on the intersections between particle and nuclear physics, Tucson, AZ (United States), 23-29 May 1991). Order Number DE92000856. Source: OSTI; NTIS; INIS; GPO Dep.

Mini-jet and particle production are studied in the framework of HIJING Monte Carlo model which can describe pp and $p\bar{p}$ collisions well from ISR to Fermilab Tevatron energies. Mini-jets are shown to have eminent contributions to particle production in ultra-relativistic heavy ion collisions. However, parton shadowing and jet quenching also have important effects and can be studied by single particle distributions. 19 refs., 5 figs.

**35212** (LBL–31040) **Update to the RHIC Letter of Intent for an experiment on particle and jet production at midrapidity.** The STAR Collaboration. Lawrence Berkeley Lab., CA (United States). Jul 1991. 51p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000724. Source: OSTI; NTIS; INIS; GPO Dep.

This document is an Update to the Letter of Intent (LOI) submitted by this collaboration in September 1990 proposing a large acceptance solenoidal tracking experiment. Since that time the collaboration has chosen the name STAR, representing Solenoidal Tracker At RHIC. The physics interests of the STAR collaboration and the goals of the experiment are described in the original LOI. Since submission of the LOI, several changes have been made in the design of the experiment motivated by the desire to expand pseudorapidity coverage for complete event characterization and by the necessity to achieve cost reduction. The major changes are: Expansion of pseudorapidity coverage to $|\eta| < 4.5$ by the addition of tracking chambers external to the magnet; reduction in the number of time-of-flight channels from 100K to 10K; staging implementation of hadronic calorimetry while using tracking and electromagnetic calorimetry to extract parton physics in the initial configuration; reduction in the cost per channel of Time Projection Chamber (TPC) electronics through continued TPC electronics

R&D supported from RHIC funds; and a change in the Silicon Vertex Tracker (SVT) technique to the use of silicon drift chambers. These changes and the status of ongoing R&D programs to optimize the design and performance of the STAR experiment will be presented. In terms of detector performance it will be demonstrated that the space charge loading of the TPC is negligible and that the STAR experiment can operate at the highest RHIC luminosities. A summary of the detector systems is presented in this paper.

**35213** (SLAC–381) **A measurement of the branching ratio of the Z boson to bottom quarks using precision tracking.** Jacobsen, R.G. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Jul 1991. 155p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. Order Number DE91019004. Source: OSTI; NTIS; INIS; GPO Dep.

We use the precision vertex detectors installed in the Mark 2 detector to measure $R_b$, the fraction of $Z^0$ bosons decays into hadrons that include bottom quarks. The $Z^0$ bosons were created via $e^+e^-$ annihilation at 91 GeV by the Stanford Linear Collider during the 1990 running. The Mark 2 tracking system, including the Silicon Strip Vertex Detector and Drift Chamber Vertex Detector, achieves a track position resolution of better than 20 microns for high momentum tracks at the collision point. We describe procedures used to obtain this resolution, including alignment of the Silicon Strip Vertex Detector, and techniques used to quantify the achieved resolution. We can, for the first time, measure the impact parameters of tracks accurately enough to use the finite b quark lifetime to tag a sample of events containing b quarks. This is done by requiring events which contain at least three tracks with impact parameter greater than three times the calculated impact parameter error. The b quark tagging efficiency is 48% and 85% of the tagged sample events contain b quarks. Using the 29 events tagged out of a total of 220 identified hadronic $Z^0$ decays, we measure $R_b \equiv Br(Z^0 \rightarrow b\bar{b})/Br(Z^0 \rightarrow hadrons) = 0.230 \pm 0.048 \pm 0.030$ where the first error is statistical and the second is systematic. This value of $R_b$ is in good agreement with existing measurements made using other methods and the Standard Model prediction of 0.22 using a $\sin^2\theta_W$ value of 0.225.

**35214** (SLAC-PUB–4977) **Measuring the mass and width of the $Z^0$: The status of the energy spectrometers.** Rouse, F. (Lawrence Berkeley Lab., CA (United States)); Levi, M.; Kent, J.; King, M.; Von Zanthier, C.; Watson, S.; Bambade, P.; Erickson, R.; Jung, C.K.; Nash, J.; Wormser, G. Lawrence Berkeley Lab., CA (United States). May 1989. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515 ;AC03-76SF00098 ;AM03-76SF00010. (LBL–27160;CONF-8902110–6: 2. international symposium on the fourth family of quarks and leptons, Santa Monica, CA (United States), 23-25 Feb 1989). Order Number DE92000939. Source: OSTI; NTIS; INIS; GPO Dep.

The Stanford Linear Collider (SLC) located at the Stanford Linear Accelerator Center (SLAC) collides electrons and positrons produced in the linear accelerator pulse by pulse. The object is to produce collisions energetic enough to produce the heavy intermediate vector boson, the $Z^0$. An essential component of the SLC physics program is the precise knowledge of the center-of-mass energy of each interaction. We measure the energy of each collision by using two energy spectrometers. The spectrometers are located in extraction lines of each beam. We will measure the energy of each beam to 20 MeV or 5 parts in $10^4$. We report here on the status of the energy spectrometer system. 13 refs., 7 figs., 3 tabs.

**35215** (SLAC-PUB–5600) **A search for the production of the final states $\tau^+\tau^-e^+e^-$, $\tau^+\tau^-\mu^+\mu^-$, and $\tau^+\tau^-\pi^+\pi^-$ in $e^+e^-$ collisions at $\sqrt{s}$ = 29 GeV.** The Mark II (at PEP) Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (United States); Lawrence Berkeley Lab., CA (United States); Harvard Univ., Cambridge, MA (United States). Dept. of Physics. Jul 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (LBL–31178;CONF-9107172–1: 15. joint international lepton photon symposium at high energies and European Physical Society (EPS) conference on high energy, Geneva (Switzerland), 25 Jul - 1 aug 1991). Order Number DE91018884. Source: OSTI; NTIS; INIS; GPO Dep.

We have searched for the reaction $e^+e^- \rightarrow \tau^+\tau^-f\bar{f}$, where f is either an electron, muon, or charged pion, at $\sqrt{s}$ = 29 GeV using the Mark 2 detector at the PEP storage ring. One candidate event is found while 2.3 events are expected from known processes. We would expect to see 11 events if the cross-section for $e^+e^- \rightarrow \tau^+\tau^-f\bar{f}$ at $\sqrt{s}$ = 29 GeV were enhanced by the factor of 4.7 which the ALEPH collaboration reports for $\sqrt{s}$ = 91 GeV. we also look for $e^+e^- \rightarrow e^+e^-f\bar{f}$ and $e^+e^- \rightarrow \mu^+\mu^-f\bar{f}$, and for $e^+e^- \rightarrow \tau^+\tau^-\gamma$ using a similar analysis procedure and see the number of events predicted by the standard model. 10 refs., 5 figs., 3 tabs.

**35216** (SLAC-PUB–5619) **Constraints placed on the Higgs sector from precision electroweak measurements.** Takeuchi, Tatsu. Stanford Linear Accelerator Center, Menlo Park, CA (United States). Sep 1991. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00515. (CONF-9104299–1: 1991 Nagoya spring school on dynamical symmetry breaking, Nakatsugawa, Gifu-ken (Japan), 23-27 Apr 1991). Order Number DE92000236. Source: OSTI; NTIS; INIS; GPO Dep.

In this lecture, I would like to investigate what precision electroweak measurements have to tell us about the Higgs sector. I will show that the radiative corrections to electroweak interaction observables coming from the Higgs sector can be summarized into three parameters S, T, and U. The precision measurements of the observables will constrain S and T. By comparing these constraints with the theoretically predicted values of S and T, we will be able to tell which Higgs sector theories are more viable than others. 24 refs., 3 figs.

## 6452 Particle Interactions and Properties - Theoretical

*Refer also to citation(s) 35190, 35195, 35209, 35216, 35242, 35253, 35291, 35292, 35294, 35296, 35297, 35299, 35301, 35308, 35311*

**35217** (DESY–91-035) **Constraints of dynamical symmetry breaking mechanisms from electroweak data.** Ali, A.; Degrassi, G. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Apr 1991. 19p. Order Number DE92714309. Source: OSTI; NTIS (US Sales Only); INIS.

Consistency of the Salam-Weinberg theory, including quantum corrections, with high precision data from LEP and elsewhere imposes non-trivial bounds on the parameters of this theory, in particular the top quark mass. We take stock of the available experimental information in the electroweak sector with the view of constraining possible additional interactions, such as present in dynamical symmetry breaking scenarios. Using the Peskin-Takeuchi isospin conserving, S and -violating, T, parametrization of new physics contribution to vacuum polarization corrections, we show here that the full one family technicolor models are ruled out at the 95% C.L. from the LEP data and $m_W$-measurements alone. We stress the role of improved precision measurements of the W-boson mass and the decay width $\Gamma(Z \rightarrow b\text{anti } b)$ in the enhanced sensitivity gained on such interactions. (orig.).

**35218** (DESY–91-039) **Associate production of a heavy quark and a gauge boson at $e^{\pm}p$ colliders.** Drees, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Gruppe Theorie); Kim, C.S. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Apr 1991. 28p. (DTP–91/16). Order Number DE92714305. Source: OSTI; NTIS (US Sales Only); INIS.

We study the reaction $e+p \rightarrow e+Q+V+X$, where Q stands for a c or b quark and $V=\gamma$, W or Z. At HERA only the combination Q=c, $V=\gamma$ seems promising; it should allow to measure the c quark density inside both the proton and the photon. Here, c quarks are identified through their muonic decays. At LEPxLHC, $\gamma$+b(anti b) and $W^{\pm}$+c(anti c) production also have sizeable rates; The first reaction might allow to measure the b content of the photon, while the second reaction can determine the strange-sea and the valence d-quark distributions in the proton, and might provide a statistically independent measurement of the WW$\gamma$ vertex. (orig.).

35219 (DESY–91-041) **Asymptotic solutions of the evolution equation for the polarized nucleon structure function $g_2(x,Q^2)$.** Ali, A. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Braun, V.M.: Hiller, G. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 15p. (HD-THEP–91-09). Order Number DE92714430. Source: OSTI; NTIS (US Sales Only); INIS.

We show that quark operators of twist 3 contributing to the polarized nucleon structure function $g_2^{tw.3}(x, Q^2)$ decouple from the evolution equation for the quark-gluon operators of the same twist in two important limits, $N_c \to \infty$ and $n \to \infty$ ($N_c$ is the number of colours and n refers to the n-th moment of $g_2$). The anomalous dimensions for the quark operators turn out to be always the lowest ones in the spectrum. Asymptotic behaviour of $g_2(x, Q^2)$ in the region $1-x << 1$ is derived. Results of an extensive numerical study of the spectrum of anomalous dimensions for QCD and for the $N_c \to \infty$ cases are presented. (orig.).

35220 (DESY–91-045) **A practical introduction to electroweak radiative corrections.** Drees, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Gruppe Theorie). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 27p. Order Number DE92714433. Source: OSTI; NTIS (US Sales Only); INIS.

This is a brief introduction into electroweak radiative corrections within the Standard Model, with the emphasis on performing actual calculations. To this end, a complete set of expressions is given that allows the computation of the $\rho$ parameter, the W mass, and Z→fanti f decays for massless fermions, where the anti Manti S scheme has been used. I conclude with an assessment of what we have learned so far from electroweak precision experiments, and a brief outlook. (orig.).

35221 (DESY–91-050) **On the possibility of resonances in longitudinally polarized vector boson scattering.** Veltman, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Veltman, M. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 29p. Order Number DE92714432. Source: OSTI; NTIS (US Sales Only); INIS.

Assuming that no Higgs has been found below 1 TeV, we study the physics of longitudinally polarized vector boson ($W_L$) scattering in the TeV region, using a one loop calculation and partial wave analysis. We show that the occurence of a resonance in the isospin I=1 channel depends on a certain parameter called $\beta$, which is measured near threshold. We investigate the similarity between low energy $\pi\pi$ scattering and high energy $W_LW_L$ scattering, as suggested by the equivalence theorem. (orig.).

35222 (DESY–91-053) **Neutrino masses, neutral vector bosons and the scale of B-L breaking.** Buchmueller, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Greub, C.; Minkowski, P. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 9p. Order Number DE92714435. Source: OSTI; NTIS (US Sales Only); INIS.

Extensions of the standard model with extra neutral vector bosons predict additional fermions whose allowed masses are constrained by the masses of the new vector bosons. For the minimal case with one extra Z' boson and an extended gauge group contained in the unified group SO(10), we derive upper and lower bounds on the masses of heavy Majorana neutrinos. We also discuss implications for the standard model Higgs boson. (orig.).

35223 (DESY–91-054) **Heavy quark production in panti p interaction at collider energies.** Levin, E.M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Ryskin, M.G.; Shabelski, Yu.M.; Shuvaev, A.G. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 10p. Order Number DE92714441. Source: OSTI; NTIS (US Sales Only); INIS.

Here we compare the new data on b-quark production with prediction of the naive parton model and semihard approach, based on perturbative QCD. We claim that semihard approach gives the good description of CDF data on beauty production, so we have now in hands the parametrization of gluon structure function that allows us to predict heavy quark production at higher (LHC and SSC) energies. (orig.).

35224 (DESY–91-058) **On semileptonic B decays into longitudinally polarized $\rho$ mesons.** Manakos, P. (Technische Hochschule Darmstadt (Germany, F.R.)); Mannel, T. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 11p. Order Number DE92714443. Source: OSTI; NTIS (US Sales Only); INIS.

The heavy quark limit can not be taken directly for the decay $B \to \rho e\nu$ if the $\rho$ meson is longitudinally polarized. We employ some recent ideas of a special realization of chiral symmetry to relate the above process to the decay $B \to \pi e\nu$ in the heavy quark limit, which corresponds to the chiral limit in this so called vector realization of chiral symmetry. (orig.).

35225 (DESY–91-059) **Renormalization scheme dependence and infrared behaviour in $e^+e^-$ annihilations and $\tau$-lepton decay at the next-to-next-to-leading order of perturbative QCD.** Chyla, J. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Fyzikalni Ustav); Kataev, A.; Larin, S. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 21p. Order Number DE92714429. Source: OSTI; NTIS (US Sales Only); INIS.

We present a detailed investigation of the renormalization scheme dependence of the next-to-next-leading order QCD predictions for the processes $e^+e^- \to$hadrons and $\tau \to \nu_\tau +$hadrons. The comparison of the results obtained in three frequently used approaches to resolving the renormalization scheme ambiguities with experimental data is carried out and special features of the approximants in the infrared and ultraviolet regions are analysed. (orig.).

35226 (DESY–91-061) **Bounds on the top mass from Z decays into b quarks.** Djouadi, A. (Technische Hochschule Aachen (Germany, F.R.). Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 9p. (CONF-9103200–: 26. Rencontres de Moriond conference, Les Arcs (France), 10-24 Mar 1991). Order Number DE92714444. Source: OSTI; NTIS (US Sales Only); INIS.

I discuss the information that can be obtained on the top quark mass from high-precision measurements in the decay $Z \to b\bar{b}$ which are performed at LEP. I will show that there are two completely independent ways to constrain this parameter: While the forward-backward asymmetry $A_{FB}{}^b$ directly measures the top effect stemming from gauge boson self-energies and which affect all electroweak observables, the ratio of decay widths $\Gamma_b = \Gamma(Z \to b\bar{b})/\Gamma(Z \to \text{hadrons})$ is only sensitive to the top effect due to vertex corrections. Non genuine electroweak effects on the two observables as well as possible effects due to New Physics are also discussed. (orig.).

35227 (FNAL/C–91/200) **Hyperons: Insights into baryon structures.** Lach, J. Fermi National Accelerator Lab., Batavia, IL (United States). Aug 1991. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-901283–2: 4. Mexican school on particles and fields, Oaxtepec (Mexico), 3-14 Dec 1990). Order Number DE91018890. Source: OSTI; NTIS; INIS; GPO Dep.

The baryon octet is composed mainly of hyperons. Modern high energy hyperon beams provide a tool for the study of hyperon static properties and interactions. Experiments with these beams have provided new insights into hyperon rare decays, magnetic moments, and interactions. These experiments provide us with insights into the strong, weak, and electromagnetic structure of the baryons. 65 refs., 45 figs., 5 tabs.

35228 (FNAL/C–91/225) **Jet rates from deep inelastic muon scattering in the W range of 15 to 35 GeV.** Salgado, C. E665 Collaboration. Fermi National Accelerator Lab., Batavia, IL (United States). Aug 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH03000. (CONF-910881–14: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000470. Source: OSTI; NTIS; INIS; GPO Dep.

Production rates of forward jets in deep inelastic muon scattering are studied using the JADE jet finding algorithm. The evolution of di-jet rates with W is compared to QCD first order predictions in the W range of 15 to 25 GeV. 7 refs., 3 figs.

**35229** (LA-UR–91-3038) **Muonium to antimuonium conversion and the decay $\mu^+ \rightarrow e^+ \nu_e \nu_\mu$ in left-right symmetric models.** Herczeg, P. (Los Alamos National Lab., NM (United States)); Mohapatra, R.N. Los Alamos National Lab., NM (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910881–10: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000195. Source: OSTI; NTIS; INIS; GPO Dep.

We investigate muonium to antimuonium conversion and the exotic muon decay $\mu^+ \rightarrow e^+ \bar{\nu}_e \epsilon_\mu$ in $SU(2)_L \times SU(2)_R \times U(1)_{B-L}$ models. 7 refs.

**35230** (ORNL/CCIP–91/25) **A Monte Carlo study of the light $q^2\bar{q}^2$ system.** Grondin, G. (Toronto Univ., ON (Canada). Dept. of Physics). Oak Ridge National Lab., TN (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States); Natural Sciences and Engineering Research Council of Canada, Ottawa, ON (Canada); Tennessee State Government, Nashville, TN (United States); Stevens (E.C.) Fellowship (United States). DOE Contract AC05-84OR21400 ;AS05-76ER03956. Contract R01-1062-32. (UTK–91/09;UTPT–91/23;CONF-910864–1: 4. international conference on hadron spectroscopy, College Park, MD (United States), 12-16 Aug 1991). Order Number DE92000449. Source: OSTI; NTIS; INIS; GPO Dep.

We present results from a Guided Random Walk Monte Carlo simulation of the light (q = u, d) $q^2\bar{q}^2$ system in a Coulomb-plus-linear quark potential model using an Intel iPSC/860 hypercube. We find evidence for no bound states below the vector-vector threshold in the (J,I) = (2,2) and (2,0) sector. 14 refs., 2 figs.

## 6453 Particle Invariance Principles and Symmetries

*Refer also to citation(s) 35236, 35243*

**35231** (DESY–91-037) **Quasi Hopf quantum symmetry in quantum theory.** Mack, G. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik); Schomerus, V. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 39p. Order Number DE92714304. Source: OSTI; NTIS (US Sales Only); INIS.

In quantum theory, internal symmetries more general than groups are possible. We show that quasitriangular quasi Hopf algebras $G^*$ as introduced by Drinfeld permit a consistent formulation of a transformation law of states in the physical Hilbert space H, of invariance of the ground state, and of a transformation law of field operators which is consistent with local braid relations of field operators as proposed by Froehlich. All this remains true when Drinfelds axioms are suitably weakened in order to build in truncated tensor products. Conversely, all the axioms of a weak quasitriangular quasi Hopf algebra are motivated from what physics demands of a symmetry. Unitarity requires in addition that $G^*$ admits a*-operation with certain properties. Invariance properties of Greens functions follow from invariance of the ground state and covariance of field operators as usual. Covariant adjoints and covariant products of field operators can be defined. The R-matrix elements in the local braid relations are in general operators in H. They are determined by the symmetry up to a phase factor. Quantum group algebras like $U_q(sl_2)$ with vertical strokeqvertical stroke=1 are examples of symmetries with special properties. We show that a weak quasitriangular quasi Hopf algebra $G^*$ is canonically associated with $U_q(sl_2)$ if $q^P$=-1. We argue that these weak quasi Hopf algebras are the true symmetries of minimal conformal models. Their dual algebras G ('functions on the group') are neither commutative nor associative. (orig.).

**35232** (INIS-BR–2702, pp. 3-16) **Chiral symmetry: breaking and restoration in the nucleus.** Krein, G. (Santa Maria Univ., RS (Brazil). Dept. de Fisica). Sociedade Brasileira de Fisica, Sao Paulo, SP (Brazil). 1990. 382p. (In Portuguese). (CONF-9009301–: 13. Workshop on Nuclear Physics in Brazil, Caxambu (Brazil), 2-6 Sep 1990). In *Proceedings of the 13. Workshop on Nuclear Physics in Brazil.* Order Number DE91643436. Source: OSTI; NTIS (US Sales Only); INIS.

The dynamical chiral symmetry breaking and its restoration in nucleus is studied. The chiral symmetry is discussed in the context of QCD. The Nambu-Jona-Lasinio model is presented as prototype model for carrying out the chiral symmetry in QCD and, to describe its restoration in function of the density of quarks. The consequences on Nuclear Physics of partial chiral symmetry restoration as function of the nuclear density are analysed. (M.C.K.).

**35233** (LA-UR–91-2926) **The riddle of high-energy baryon number violation.** Mattis, M.P. Los Alamos National Lab., NM (United States). Sep 1991. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE92000253. Source: OSTI; NTIS; INIS; GPO Dep.

The exciting possibility that anomalous baryon and lepton number violation might be observable at the next generation of supercolliders is suggested by an instanton calculation due to Ringwald and Espinosa. In these Lectures, the current controversial status of these claims is discussed, and several new technologies designed to analyze this question are reviewed. These technologies should contribute more generally to our understanding of weakly- coupled field theories in the nonperturbative regime where both energies and multiplicities are very large. 61 refs., 35 figs.

**35234** (LA-UR–91-3063) **Physical interpretation of supercoherent states and their associated Grassmann numbers.** Nieto, M.M. Los Alamos National Lab., NM (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9105251–2: Meeting on the foundation of quantum mechanics, Santa Fe, NM (United States), 27-31 May 1991). Order Number DE92000187. Source: OSTI; NTIS; GPO Dep.

A physical interpretation of supercoherent states is suggested. It is based upon the observation that an ordinary coherent state is an eigenstate of a specific mode of the radiation field. A supercoherent state is viewed as a photino coherently combined with photons of the same mode. An interpretation of the associated Grassmann-valued numbers of the state is also discussed. 13 refs.

## 6454 Field Theory

*Refer also to citation(s) 35233*

**35235** (DESY–91-040) **Color confinement, abelian dominance and the dynamics of magnetic monopoles in SU(3) gauge theory.** Brandstaeter, F. (Hoechstleistungsrechenzentrum (HLRZ), Juelich (Germany, F.R.). Gruppe Theorie der Elementarteilchen); Wiese, U.J.; Schierholz, G. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 18p. (HLRZ–91-37). Order Number DE92714306. Source: OSTI; NTIS (US Sales Only); INIS.

Extending earlier work, we investigate the vacuum structure of the pure SU(3) gauge theory in the maximally abelian gauge. In this gauge the long-distance physics is carried essentially by the abelian degrees of freedom. Monopoles show up as particle-like singularities in the gauge fixing procedure. We find evidence that these monopoles condense in the confined phase of the vacuum, in accord with the picture of a dual superconductor, whereas they are dilute and increasingly static as the temperature increases in the deconfined phase. (orig.).

**35236** (DESY–91-042) **WZW superconformal blocks from three dimensions.** McArthur, I.N. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 18p. Order Number DE92714311. Source: OSTI; NTIS (US Sales Only); INIS.

A three-dimensional theory whose canonical quantization yields wavefunctions which can be identified with the superconformal blocks of two-dimensional super-Wess-Zumino-Witten theory is presented. In particular, the anomalous Ward identities satisfied by the superconformal blocks in the presence of a supergauge background are reproduced in terms of constraints obeyed by the wavefunctions of the three-dimensional theory. The action contains the bosonic Chern-Simons action but does not possess a three-dimensional supersymmetry. The 'time' coordinate plays the role of an interpolating parameter between two-dimensional superconnections. The structure of the Hilbert space of the theory is examined. (orig.).

35237 (DESY–91-043) **Field operators for anyons and plektons.** Rehren, K.H. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 30p. Order Number DE92714431. Source: OSTI; NTIS (US Sales Only); INIS.

Given its superselection sectors with non-abelian braid group statistics, we extend the algebra A of local observables into an algebra F containing localized intertwiner fields which carry the superselection charges. The construction of the inner degrees of freedom, as well as the study of their transformation properties (quantum symmetry), are entirely in terms of the superselection structure of the observables. As a novel and characteristic feature for braid group statistics, Clebsch-Gordan and commutation 'coefficients' generically take values in the algebra M of symmetry operators, much as it is the case with quasi-Hopf symmetry. A, F, and M are all C* algebras, i.e. represented by bounded operators on a Hilbert space with positive metric. (orig.).

35238 (DESY–91-052) **Signatures of unstable particles in finite volume.** Luescher, M. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 20p. Order Number DE92714437. Source: OSTI; NTIS (US Sales Only); INIS.

Unstable particles (resonances) occur in QCD, the Higgs model and many other quantum field theories of interest. Since they are a dynamical phenomenon, showing up in scattering processes of stable particles, it is not obvious how to extract their masses from numerical simulations of the theory in euclidean space. For resonances in the elastic region, a solution to this problem in proposed here on the basis of a recently established relation between the scattering matrix in infinite volume and the two-particle energy spectrum in a periodic box. (orig.).

35239 (DESY–91-060) **Quasi quantum group symmetry and local braid relations in the conformal Ising model.** Mack, G. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik); Schomerus, V. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 10p. Order Number DE92714428. Source: OSTI; NTIS (US Sales Only); INIS.

We propose that the true quantum symmetries of minimal conformal models are weak quasitriangular quasi Hopf algebras ('quasi quantum groups') canonically associated with $U_q(sl_2)$, rather than the quantum group algebras $U_q(sl_2)$ themselves. We show by construction that the conformal Ising model admits quasi Hopf covariant field operators which obey quasi Hopf covariant operator product expansions and local braid relations. Both are valid as operator identities on the whole positive definite physical Hilbert space. (orig.).

35240 (DESY–91-062) **Dirac versus Wigner: Towards a universal particle concept in local quantum field theory.** Buchholz, D. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik); Porrmann, M.; Stein, U. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). Jun 1991. 10p. Order Number DE92714445. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the concept of particle weight a unified description of stable particle like systems in local quantum field theory is given which applies also to so called infraparticles. Particle weights carry definite charge, four momentum and spin and give rise to characteristic mass shell singularities. A collision theory for these weights is proposed which allows to calculate transition probabilities directly from local gauge invariant operators. (orig.).

35241 (JINR-D–4-89-221, pp. 42-54) **Relativistic kinematics of the relative motion.** Manoff, S. (Bylgarska Akademiya na Naukite, Sofia (Bulgaria). Inst. za Yadrena Izsledvaniya i Yadrena Energetika). Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Relativistic kinematics of the relative motion is discussed. A general scheme of solving the problem in the general case of vector fields using differentiable manifolds with affine connection and metric is obtained. 11 refs.; 2 tabs.

35242 (LA-UR–91-3023) **Monte Carlo approaches to effective field theories.** Carlson, J. (Los Alamos National Lab., NM (United States)); Schmidt, K.E. Los Alamos National Lab., NM (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9108142–3: Recent progress in many-body theories, Minneapolis, MN (United States), 26-31 Aug 1991). Order Number DE92000198. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper, we explore the application of continuum Monte Carlo methods to effective field theory models. Effective field theories, in this context, are those in which a Fock space decomposition of the state is useful. These problems arise both in nuclear and condensed matter physica. In nuclear physics, much work has been done on effective field theories of mesons and baryons. While the theories are not fundamental, they should be able to describe nuclear properties at low energy and momentum scales. After describing the methods, we solve two simple scalar field theory problems; the polaron and two nucleons interacting through scalar meson exchange. The methods presented here are rather straightforward extensions of methods used to solve quantum mechanics problems. Monte Carlo methods are used to avoid the truncation inherent in a Tamm-Dancoff approach and its associated difficulties. Nevertheless, the methods will be most valuable when the Fock space decomposition of the states is useful. Hence, while they are not intended for ab initio studies of QCD, they may prove valuable in studies of light nuclei, or for systems of interacting electrons and phonons. In these problems a Fock space decomposition can be used to reduce the number of degrees of freedom and to retain the rotational symmetries exactly. The problems we address here are comparatively simple, but offer useful initial tests of the method. We present results for the polaron and two non-relativistic nucleons interacting through scalar meson exchange. In each case, it is possible to integrate out the boson degrees of freedom exactly, and obtain a retarded form of the action that depends only upon the fermion paths. Here we keep the explicit bosons, though, since we would like to retain information about the boson components of the states and it will be necessary to keep these components in order to treat non-scalar of interacting bosonic fields.

35243 (LBL–31192) **Recent developments in the Virasoro master equation.** Halpern, M.B. Lawrence Berkeley Lab., CA (United States). 3 Sep 1991. 17p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract AC03-76SF00098. Grant PHY90-21139. (CONF-9105113–3: Strings and symmetries conference, Stony Brook, NY (United States), 20-25 May 1991; UCB-PTH–91/43). Order Number DE92000811. Source: OSTI; NTIS; INIS; GPO Dep.

The Virasoro master equation collects all possible Virasoro constructions which are quadratic in the currents of affine Lie g. The solution space of this system is immense, with generically irrational central charge, and solutions which have so far been observed are generically unitary. Other developments reviewed include the exact C-function, the superconformal master equation and partial classification of solutions by graph theory and generalized graph theories. 37 refs., 1 fig., 1 tab.

# 65 PHYSICS II

*Refer also to citation(s) 35185*

## 6510 Nuclear Physics

*Refer also to citation(s) 34774, 35193, 35208, 35211, 35293, 35295, 35301, 35303, 35432, 35451, 35482*

35244 (BNL–44911, pp. 70-78) **Recent results from EMU01.** Stenlund, E. (Univ. of Lund (Sweden)); Garpman, S.; Jakobsson, B.; Otterlund, I.; Persson, S.; Soederstrom, K.; Adamovich, M.I.; Alexandrov, Y.A.; Chernyavski, M.M.; Gerassimov, S.G.; Kharlamov, S.P.; Larinova, V.G.; Maslennikova, N.V.; Orlova, G.I.; PeresBrookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7

Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

In this talk the authors will summarize the recent results from the EMU01-collaboration on heavy-ion collisions at both AGS- and SPS-energies. They will focus on the global observables like multiplicities and pseudo-rapidity distributions, and especially look at fluctuations in particle densities, the energy dependence and the importance of the nuclear geometry.

**35245** (BNL–44911, pp. 80-101) **Experimental results concerning global observables from the CERN SPS heavy ion program.** Young, G.R. (Oak Ridge National Lab., TN (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

CERN has accelerated ions of mass 16 (oxygen) to energies of 60 and 200 GeV/nucleon and of mass 32 (sulfur) to energies of 200 GeV/nucleon. This yields total energies of 960 GeV and 3.2 TeV for the $^{16}O$ and 6.4 TeV total for the $^{32}S$. Upgrade plans for CERN call for construction of a high-frequency ECR source capable of producing $^{208}Pb$ in charge state 25-30$^{+}$. One can obtain information on the global distribution of energy and produced particles in heavy-ion reactions by measuring the transverse energy and number of produced particles as a function of pseudorapidity and azimuth over a large region centered at mid-rapidity. The energy measurements are accomplished in the usual way via a set of calorimeter towers divided into electromagnetic and hadronic compartments. The multiplicity measurements are performed using large acceptance tracking devices (streamer chambers or TPCs) or large arrays of larrocci-type streamer tubes with pad readout. Using a suggestion of Bjorken it is possible to relate the measured transverse energy per unit rapidity, $dE_T/dy$, to the energy density produced in the reaction, modulo an uncertainty arising from an imperfect knowledge of the proper time required for the final state particles to hadronize. If the particle multiplicity proved to be a linear function of the transverse energy (or vice versa), as it is found to be, it is also possible to estimate the energy density from the particle multiplicity. It should also be possible to relate the entropy density to the observed particle multiplicity. Some experimental results of $^{32}S$ collisions on $^{197}Au$, Ag, Cu, and $^{27}Al$ and $^{11}O$ collisions on Cu, Ag, $^{197}Au$, $^{12}C$ are given.

**35246** (BNL–44911, pp. 227-239) **810 future plans.** Platner, E.D. (Brookhaven National Lab., Upton, NY (USA)); Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Saulys, A.C.; Lindenbaum, S.J.; Chan, C.S.; Kramer, M.A.; Hallman, T.J.; Madansky, L.; Bonner, B.E.; Buchanan, J.Brookhaven National Lab., Upton, NY (United States). [1990]. DOE Contract AC02-83ER40107 ;AS05-81ER40032 ;AC02-76ER03274. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

It is believed that a good bet for finding the Quark-Gluon Plasma at AGS energies is with the heaviest projectiles on the heaviest target, i.e. Au on Au. One of the likely signatures of the plasma is strangeness enhancement. Al Saulys has shown what it's like to find $\Lambda$ and $K^{O}$ with Si projectiles. The Monte Carlo simulations show track densities 4× higher for Au projectiles. In addition, the Au beam itself produces 30 times more ionization. Thus the present TPC's will be limited to only a few hundred ions per sec.

**35247** (BNL–44911, pp. 249-260) **E802: Baryons and antibaryons.** Costales, J.B. (Massachusetts Inst. of Tech., Cambridge (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

Data for the production of protons, deuterons and antiprotons in p + A and Si + A collisions using the E802 spectrometer at the BNL AGS are presented. For protons, the spectrometer acceptance ranges from rapidities y of 0.5 to roughly 1.7 (the beam rapidity for 14.6 A·GeV/c projectiles is 3.44) and transverse momenta $p_\perp$ greater than roughly 0.3 GeV/c. Because of limited statistics, data for antiproton production are limited to the rapidity range of 1.1 to 1.6. The invariant cross sections of protons, deuterons and antiprotons at fixed rapidity are well described by exponentials in transverse mass $m_\perp \equiv \sqrt{m_o^2 + p_\perp^2}$, dramatically increases both as a function of the combined projectile and target mass and as a function of rapidity. Results for dN/dy are also presented and comparisons with models are shown.

**35248** (BNL–44911, pp. 261-294) **Recent CERN results on HBT, strangeness and $p_T$-spectra from $^{16}O$,$^{32}S$-nucleus collisions at 200 GeV/nucleon.** Seyboth, P. (Max-Planck-Inst. fuer Physik und Astrophysik, Munich (West Germany)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

In experiments with the CERN-SPS beams of oxygen and sulphur ions, large initial energy densities in excess of 2 GeV/fm$^3$ have been observed in collisions with heavy nuclear targets. According to QCD calculations on the lattice the deconfinement of quarks and gluons may start to set in at such energy densities. Some interesting signals such as suppression of J/Ψ production and an unexpectedly large pion emission region were seen. The analysis of the data taken by the CERN experiments in 1986 and 1987 has continued and recent preliminary results on pion interferometry (experiments NA35, WA80), strangeness production (experiments NA34, NA35, NA38, WA85) and $p_T$-spectra (experiment NA35) will be shown. Data taking with improved detectors and two new experiments will resume at CERN this year with sulphur beams and is expected to continue in 1991.

**35249** (BNL–44911, pp. 300-313) **Dilepton production: Results from the Bevalac extensions to the AGS.** Schroeder, L.S. (Lawrence Berkeley Lab., CA (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. DOE Contract AC03-76SF00098. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

A central focus of studying nucleus-nucleus collisions at energies ranging from the Bevalac to the AGS and SPS and eventually at RHIC, is the study of nuclear matter under extreme conditions of density and temperature. In order to achieve these conditions experimentally, one concentrates on the central collisions of the heaviest systems possible. Since the transient hot, dense phase is only expected to be present for the order of 1-3 × $10^{-23}$ seconds, one needs to seek experimental probes which will be sensitive to these early times as well as being able to survive this phase and the subsequent expansion and cooling to carry a signal to the outside world (i.e., the author's detectors). The ordinary hadrons, such as pions and protons, are strongly interacting particles which suffer considerable absorption and rescattering after production in such an environment. Thus, they are generally expected to reflect the surface properties of the system, i.e., after the expansion and cooling and eventually decoupling of the matter. However, photons and dileptons due to their weak coupling to matter, should be excellent probes of the early stages of the collision. Therefore, they are a penetrating probe which can provide relatively undistorted information concerning their creation. In addition, since they arise from electromagnetic interactions, detailed calculations can in principle be readily carried out for comparison with the experimental data.

**35250** (BNL–44911, pp. 384-401) **Studying extremely peripheral collisions of relativistic heavy ions.** Fatyga, M. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7

Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

Relativistic heavy ion facilities have been proposed (and in some cases constructed) with an intent to search for a new state of matter, a quark gluon plasma. As with all tools in the experimental physics, one should always search for ways in which relativistic heavy ions can be used to study physical phenomena beyond this original goal. New possibilities for a study of higher order photonuclear excitations in extremely peripheral collisions of relativistic heavy ions are discussed in this contribution. Data on the electromagnetic and nuclear fragmentation of a 14.6Gev/nucleon $^{28}Si$ projectile are presented.

**35251** (BNL–44911, pp. 411-420) **HBT measurements in relativistic heavy ion collisions.** Zajc, W.A. (Columbia Univ., New York, NY (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The correlations in relative momentum between identical bosons are determined, in part, by the geometrical properties of the boson source. This fact was first exploited in hadron physics by Goldhaber, Goldhaber, Lee and Pais (GGLP) in 1960. In the intervening three decades, this approach has been applied to lepton-lepton, lepton-hadron, hadron-hadron, and heavy-ion collisions. A word about nomenclature: The correlations in relative momentum between identical mesons arise from Bose statistics. Even previous to GGLP, this fact was applied by Hanbury-Brown and Twiss to measure stellar radii via two-photon interferometry. Thus an alternative name for the GGLP effect is the HBT effect. An informal introduction to Hanbury-Brown-Twiss measurements in heavy ion collisions is presented. The systematic effects in interpreting such data are emphasized, rather than the implications of any single experiment.

**35252** (BNL–44911, pp. 421-438) **Rare composite objects 2 experiments.** Sandweiss, J. (Yale Univ., New Haven, CT (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The experimental approaches to the study of rare composite objects produced in heavy ion reactions at AGS energies are discussed. The present status and future plans of experiment 814 for strangelet and antimatter studies are reviewed. The plans for future high sensitivity experiments aimed at a broad range of composite objects are presented.

**35253** (BNL–44911, pp. 439-458) **Production of rare composite objects in relativistic heavy ion collisions.** Dover, C.B. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

Relativistic heavy ion collisions in the central regime are characterized by the formation of dense, hot hadronic matter, or with luck, a region of quark-gluon plasma. The multiplicity of particles emitted from this zone of dense matter is large. In addition to pions, the dominant component, one also finds antiprotons, strange particles ($K^{\pm}$, $\Lambda\cdots$) and charmonium in the collision debris. The author discusses the production of antimatter, multiply strange objects and stable multiquark systems containing both strange and charmed quarks ($\bar{c}suud$). The possibilities for studies of charm production at RHIC energies are probed.

**35254** (BNL–44911, pp. 503-512) **Workshop on heavy ion physics at the AGS: Outlook.** Gyulassy, M. (Lawrence Berkeley Lab., CA (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. DOE Contract AC03-76SF00098. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The purpose of this workshop was to review the status of the current AGS experimental program on light ion collisions with heavy target nuclei in the laboratory energy range 10-15 AGeV, to debate what the present data may be teaching us about the physics of such reactions, and to evaluate the prospects of producing and diagnosing extreme baryon dense matter when truly heavy ion beams become available around 1992-3. This report presents the closing talk of the workshop on AGS heavy ion program held at BNL March 5-7, 1990. The emphasis is on new questions posed by the new data presented at this meeting with emphasis on the pion-proton puzzle.

**35255** (BNL–46573) **Physics opportunities with PILAC.** Chrien, R.E. Brookhaven National Lab., Upton, NY (United States). [1991]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC02-76CH00016. (CONF-9108167–1: Annual LAMPF users meeting, Los Alamos, NM (United States), 19-20 Aug 1991). Order Number DE92000128. Source: OSTI; NTIS; INIS; GPO Dep.

In the Long Range Plan prepared in 1989 for nuclear science in the 1990's, this nation's ability to maintain nuclear science at the "intellectual cutting edge" was addressed. In this document a number of facilities designed to do this were cited, including the CEBAF electron accelerator and the RHIC heavy ion accelerator. Beyond these facilities the Report noted the scientific opportunities available with a high intensity hadron facility and emphasized the importance of studies of the strong force which determines nuclear dynamics. My object in this brief survey is to discuss the physics research available in this area based on a relatively modest–at least by current standards–upgrade of the Los Alamos Meson Physics Facility, which will provide an important new tool for hadronic studies: that is PILAC, a source of pions with momenta in excess of 1 GeV/c. With PILAC a host of new opportunities for physics with pions free of the dominance of the $P_{33}$ resonance is available.

**35256** (DOE/ER/40256–6) **[Cyclotron based nuclear science]: Progress report April 1, 1990–March 31, 1991.** Texas A and M Univ., College Station, TX (United States). Cyclotron Inst. Aug 1991. 156p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER40256. Order Number DE91018530. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains descriptions of research programs carried out by Institute staff, as well as progress on new instrumentation during the period, April 1, 1990, to March 31, 1991. The K500 cyclotron and ECR source provided beam for 4140 hours during the period. The beam was actually available for experiments 1927.50 hours and 1110.50 hours was devoted to developing new beams and exploring cyclotron performance. A wide range of beams from protons to Xe with energies from 2.4 MeV/u to 60 MeV/U have been used in experiments. The highest total energy beam accelerated was 35 MeV/u $^{63}Cu$. The ECR source, made a tremendous improvement in accelerator performance and reliability. Substantial amounts of beam time were devoted to investigations of hot nuclei, electron-positron, giant resonances, atomic effects of high velocity ion beams, astrophysics related reactions and proton and alpha bremsstrahlung. Scientific accomplishments included determination of the heat capacity of nuclei through new insight into the level densities and establishing a lower limit for electron positron resonances a factor of ten better than previous measurements. The proton spectrometer, constructed for studies of the Gamow-Teller interaction is complete, and initial physics measurements will be made in the next few months. All of the $BaF_2$ crystals have been delivered and acceptance tests are underway. A K=315 MDM spectrometer has been obtained from Oxford University and is scheduled for installation in Spring 1992, after removal of the K=150 Enge split pole spectrometer. Institute groups continue participation in MEGA, instrumentation projects for RHIC, and few nucleon studies at LAMPF and KEK. Reports of these activities are included.

**35257** (DOE/ER/40316–5) **Studies of complex fragment emission in heavy ion reactions: Progress report, September**

**1, 1990–August 31, 1991.** Charity, R.J.; Sobotka, L.G. Washington Univ., St. Louis, MO (United States). 4 Sep 1991. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER40316. Order Number DE92000532. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: High energy photon production in a HI collision; the mechanism for the disassembly of excited $^{16}O$ projectiles into four alpha particles; the disassembly of excited $^{28}Si$ projectiles; large pre-fission multiplicities from temperature; dependent friction and fission barriers; multiplicity correlations; molecular beam induced fusion; dwarf ball and wall; mini wall; and computer and local data acquisition systems.

**35258** (DOE/ER/40406–4) **Investigations of nuclear structure and nuclear reactions induced by complex projectiles: Progress report, September 1, 1990–August 31, 1991.** Sarantites, D.G. Washington Univ., St. Louis, MO (United States). Dept. of Chemistry. [1991]. 52p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-88ER40406. Order Number DE92000533. Source: OSTI; NTIS; INIS; GPO Dep.

The research program of our group touches five areas of nuclear physics: (1) Nuclear structure studies at high spin; (2) Studies at the interface between structure and reactions; (3) Production and study of hot nuclei; (4) Incomplete fusion and fragmentation reactions; and (5) Development and use of novel techniques and instrumentation in the above areas of research. The papers from these areas are discussed in this report.

**35259** (DOE/ER/40414–4) **Studies of heavy-ion reactions and transuranic nuclei: Progress report, September 1, 1990–August 31, 1991.** Schroeder, W.U.; Huizenga, J.R. Rochester Univ., NY (United States). Aug 1991. 13p. Sponsored by USDOE, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract FG02-88ER40414. Order Number DE92000636. Source: OSTI; NTIS; INIS; GPO Dep.

The development of the "cold-fusion" episode is reviewed. Ongoing studies of compound-nucleus formation and decay via the neutron multiplicity distribution confirm the validity of conventional statistical theory. The excitation energy partition in near-barrier damped $^{58}Ni + ^{208}Pb$ collisions is found to be largely independent of the direction of net mass transfer, supporting a diffusion-like nucleon-exchange mechanism. Exclusive experiments on the heavy reaction systems $^{197}Au + ^{208}Pb$ and $^{209}Bi + ^{136}Xe$ in the Fermi-energy domain have revealed important new insights into the reaction mechanism, which is found to be dominated by damped, binary processes. The effectiveness of the neutron multiplicity as an impact-parameter filter is demonstrated. It is shown that very-heavy-ion reactions lead to transient nuclear systems with temperatures in excess of $\tau = 6$ MeV and transfer of large, aligned spins to reaction fragments. The first measurements of neutrons in coincidence with kinematically identified reaction fragments provide evidence for the binary, sequential character of dissipative collisions in the Fermi-energy domain. Also for the first time, a full event characterization was achieved for nuclear reactions in terms of neutrons and charged particles. Technical information on this experiment is provided. First results yield strong evidence for dominantly binary primary reaction dynamics of even highly dissipative $^{209}Bi + (28MeV/u)\ ^{136}Xe$ collisions, associated with several intermediate-mass fragments.

**35260** (DOE/ER/40592–1) **Nuclear physics at extreme energy density: Progress report, August 1990–April 1991.** Mueller, B. Duke Univ., Durham, NC (United States). Dept. of Physics. 15 May 1991. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-90ER40592. Order Number DE91018012. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses research performed under the following topics: relativistic parton cascade; quark-gluon plasma; and physics in strong electromagnetic fields. (LSP)

**35261** (GSI–91-1) **GSI scientific report 1990.** Grundinger, U. (ed.). Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Mar 1991. 494p. Order Number DE92704449. Source: OSTI; NTIS (US Sales Only); INIS.

This annual report contains extended abstracts about the work performed at the named institute. These concern experimental studies on the structure of exotic nuclei and high-spin states, heavy ion reactions, nuclear theory, positron production in atomic systems, few-electron systems, biological and physical radiation effects, radiochemical separation processes and chemical properties, developments of detectors, data acquisition, and computing, as well as development and operation of UNILAC, SIS, and ESR. (HSI).

**35262** (GSI–91-35(prepr.)) **Directions of heavy ion research at low and intermediate energies.** Kienle, P. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jul 1991. 19p. (CONF-9106292–: 4. international conference on nucleus-nucleus collisions (NN-4), Kanazawa (Japan), 10-14 Jun 1991). Order Number DE92714447. Source: OSTI; NTIS (US Sales Only); INIS.

Recent developments and advances in heavy ion research at low and intermediate energies are reviewed. Emphasis is layed on the progress of accelerator technology, especially in producing high phase space density heavy ion beams in cooler-storage rings. A report is presented on some selected topics of current interest in nuclear structure research such as the production of super-heavy elements, the excitation of multi-phonon vibrational states and giant-dipole resonances. Nuclear dynamics studies from the Coulomb barrier to relativistic energies will be addressed including the production of dense heated and excited nuclear matter and the study of the properties of hadrons in such a medium. Finally, some atomic physics experiments with heavy ions will be presented with emphasis on quasi-atomic $e^+e^-$ pair production. (orig.).

**35263** (JAERI-M–91-032, pp. 7-35) **Nuclear data activities in China.** Cai Dunjiu (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy). Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1991. (CONF-9011204–: 1990 Japan Atomic Energy Research Institute (JAERI) symposium on nuclear data, Tokai (Japan), 29-30 Nov 1990; NEANDC(J)–160/U; INDC(JPN)–148/L). In *Proceedings of the 1990 symposium on nuclear data*. 459p. Order Number DE91012314. Source: OSTI; NTIS (US Sales Only); INIS.

The scientific research on nuclear physics started in China in late 1950s. At that time, a research reactor and some accelerators were built in the Institute of Atomic Energy, Beijing, and nuclear data measurement was carried out. Nuclear data compilation and evaluation were begun systematically only in 1975 when the Chinese Nuclear Data Center (CNDC) and the Chinese Nuclear Data Coordination Network (CNDCN) were set up in order to meet the requirement for developing nuclear energy, science and engineering technology. Since China was not an IAEA member at that time, only very few data from foreign publications were able to be obtained, and the own evaluation had to be done to serve our users. This situation has changed since the CNDC established the contact with IAEA/NDS, JAERI/NDC and BNL/NNDC in 1980. Especially in 1984, when the People's Republic of China became an IAEA member, international cooperation and exchange increased. CNDC, CNDCN, working groups and Chinese Committee of Nuclear Data and their objectives are described. The activities on nuclear data evaluation, the progress of nuclear data measurement and the development for future are reported. (K.I.).

**35264** (KURRI-TR–345) **Proceedings of the specialists' meeting on physics and engineering of fission and spallation, 1990.** Nakagome, Yoshihiro (ed.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Mar 1991. 118p. (In Japanese). (CONF-9008225–: Specialists' meeting on physics and engineering of fission and spallation; Specialists' meeting on physics and engineering of fission and spallation, Kumatori (Japan); KUMATORI (Japan), 2 Aug 1990; 10 jan 1991; CONF-9101117–). Order Number DE92713857. Source: OSTI; NTIS (US Sales Only); INIS.

This issue is the collection of the papers presented at the title meeting. The 10 of the presented papers are indexed individually. (J.P.N.).

**35265** (LBL–26024) **GAMUT: A computer code for $\gamma$-ray energy and intensity analysis.** Firestone, R.B. Lawrence Berkeley Lab., CA (United States). May 1991. 27p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000691. Source: OSTI; NTIS; INIS; GPO Dep.

GAMUT is a computer code to analyze $\gamma$-ray energies and intensities. It does a linear least-squares fit of measured $\gamma$-ray energies

from one or more experiments to the level scheme. GAMUT also performs a non-linear least-squares analysis of branching intensities. For both energy and intensity data, a statistical Chi-square analysis is performed with an iterative uncertainty adjustment. The uncertainties of outlying measured values and sets of measurements with $x^2/f>1$ are increased, and the calculation is repeated until the uncertainties are consistent with the fitted values. GAMUT accepts input from standard or special-format ENSDF data sets. The special-format ENSDF data sets were designed to permit analysis of more than one set of measurements associated with a single ENSDF data set. GAMUT prepares a standard ENSDF format output data set containing the adjusted values. If more than one input ENSDF data set is provided, GAMUT creates an ADOPTED LEVELS, GAMMAS data set containing the adjusted level and $\gamma$-ray energies and branching intensities from each level normalized to 100 for the strongest $\gamma$-ray. GAMUT also provides a summary of the results and an extensive log of the iterative analysis. GAMUT is interactive prompting the user for input and output file names and for default calculation options. This version of GAMUT has adjustable dimensions so that any maximum number of data sets, levels, and $\gamma$-rays can be established at the time of implementation. 6 refs.

**35266** (LBL–30798) **Nuclear Science Division, Annual report, October 1, 1988–December 31, 1990.** Poskanzer, A.M.; Deleplanque, M.A.; Firestone, R.B.; Lofdahl, J.B. (eds.). Lawrence Berkeley Lab., CA (United States). Apr 1991. 300p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000695. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains short papers of research conducted in the following areas: Low energy research program; bevalac research program; ultrarelativistic research program; nuclear theory program; nuclear data evaluation; and, 88-inch cyclotron operations.

**35267** (NIFS-DATA–11) **Partial and total electronic stopping cross sections of atoms for a singly charged helium ion, (1).** Kaneko, T. (and others); Nishihara, T.; Taguchi, T. National Inst. for Fusion Science, Nagoya (Japan). Mar 1991. 70p. Order Number DE92704305. Source: OSTI; NTIS (US Sales Only); INIS.

Partial and total electronic stopping cross sections of atoms with Z ($2 \leq Z \leq 54$) for a $He^+$ ion are tabulated and discussed on the basis of the wave-packet theory. The wave packet theory for the stopping of bound electrons has recently been developed. The main thrust of the wave packet theory is the use of momentum space representation to describe bound electrons, where the localized nature is held in the momentum distribution function. This theory yields the electronic stopping cross section of atoms and solids, and the energy-loss straggling of atoms for protons on the independent shell model. The aim of this report is to present tables of the partial and total electronic stopping cross sections for a $He^+$ ion in collisions with neutral target atoms. In this method, the core electrons belonging to an atomic shell classified by (n, 1) (n: principal quantum number, 1: angular momentum quantum number) are considered to be identical. The ensemble of such identical electrons is regarded as a wave packet of a degenerate electron gas governed by the momentum occupation probability W(q) for momentum q. (N.K.).

## 6511 Experimental Techniques

*Refer also to citation(s) 33828, 34857, 34864, 34929*

**35268** (UM-HE–90-28) **Polarization studies with radiation doped ammonia at 5 T and 1 K.** Crabb, D.G. (Michigan Univ., Ann Arbor, MI (United States). Randall Lab. of Physics). Virginia Univ., Charlottesville, VA (United States). Dept. of Physics. 16 Nov 1990. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER40261. (CONF-900924–16: 9. international symposium on high energy spin-physics, Bonn (Germany), 10-15 Sep 1990). Order Number DE91018757. Source: OSTI; NTIS; INIS; GPO Dep.

The polarization properties of radiation doped ammonia have been studied in a $^4He$ evaporation refrigerator operating at a temperature of 1 K in a magnetic field of 5 T. The effects of an intense proton beam on these properties were also studied. 10 refs., 14 figs.

## 6512 Nuclear Properties and Reactions, A = 1-5, Experimental

*Refer also to citation(s) 35287, 35400*

**35269** (KFK–4763) **Muon catalyzed fusion under compressive conditions.** Cripps, G. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik); Goel, B.; Harms, A.A. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Neutronenphysik und Reaktortechnik. Jan 1991. 71p. Order Number DE92711239. Source: OSTI; NTIS (US Sales Only); INIS.

The viability of a symbiotic combination of Muon Catalyzed Fusion ($\mu$CF) and high density generation processes has been investigated. The muon catalyzed fusion reaction rates are formulated in the temperature and density range found under moderate compressive conditions. Simplified energy gain and power balance calculations indicate that significant energy gain occurs only if standard type deuterium-tritium (dt) fusion is ignited. A computer simulation of the hydrodynamics and fusion kinetics of a spherical deuterium-tritium pellet implosion including muons is performed. Using the muon catalyzed fusion reaction rates formulated and under ideal conditions, the pellet ignites (and thus has a significant energy gain) only if the initial muon concentration is approximately $10^{17}$ $cm^{-3}$. The muons need to be delivered to the pellet within a very short-time ($\simeq$ 1 ns). The muon pulse required in order to make the high density and temperature muon catalyzed fusion scheme viable is beyond the present technology for muon production. (orig.).

## 6513 Nuclear Properties and Reactions, A = 6-19, Experimental

**35270** (BNL–44911, pp. 240-248) **Spectra and strangeness production.** Miake, Yasuo. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

Particle production ($\pi^{\pm}$, $K^{\pm}$ and $p^{\pm}$) has been measured in p + A and Si + A reactions using the E802 spectrometer. The comparison of the particle production (rapidity distributions, momentum distributions, and the integrated yields ratios) between p + Be, p + Au and central Si + Au collisions and the effects of rescattering is discussed.

**35271** (CEA-CONF–10514) **Charged-pion production in non-peripheral proton-nucleus interactions at 800 and 1600 MeV incident energies.** Cavata, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (FR). Dept. de Physique Nucleaire); Gosset, J.; Le Merdy, A.; L'Hote, D.; Lucas, B.; Poitou, J.; Valette, O.; Lemaire, M.C.; Trzaska, M.; Radvanyi, P.; Zupranski, P.; Alard, J.P.; AuCEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire. 1991. 8p. (CONF-910110–: 19. international workshop on gross properties of nuclei, Hirschegg (Austria), 14-26 Jan 1991). Order Number DE92703746. Source: OSTI; NTIS (US Sales Only).

The present work deals with experimental results obtained for proton - nucleus collisions at 0.8 and 1.6 GeV on-carbon, niobium and lead targets. The observables studied are essentially proton - like multiplicities, and pion multiplicity distributions for both $\pi^+$ and $\pi^-$ characterized by their mean values and dispersions for two types of collisions: peripheral and central. Such data are fundamental to check the ingredients of the foregoing transport theories. In the present work, we restrict ourselves just to a comparison to the LIEGE INC code with the ingredients. Detailed description of experimental set-up, data reduction procedure and experimental results are in process to be published. Only, just trigger and detector acceptances used for the analysis will be recalled.

35272 (GSI–91-14) **Excitation of the Δ resonance in proton-nucleus collisions.** Trzaska, M. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Heidelberg Univ. (Germany). May 1991. 121p. (In German). Order Number DE92704490. Source: OSTI; NTIS (US Sales Only); INIS.

In the proton-nuclus reactions p+A (A=C, Nb, Pb) at 0.8 and 1.6 GeV incident energy strong correlations between produced pions and protons in the final state can be observed. By means of different Monte-Carlo approaches these are completely explained from the decay of Δ(1232) resonances. For none of the studied systems the extracted resonance energies agree with those of the free Δ resonance. With increasing multiplicity of the event the effective mass is instead systematically shifted by 10 MeV to 70 MeV to smaller energies. The effective decay widths are compatible with the free values. An equivalent analysis of the INC data sets yields a similar behaviour of the resonance parameters in dependence on the multiplicity. From this the conclusion is to be drawn that the manifold scattering processes of the baryons and mesons, as they are modelled in the cascade, are responsible for an effective shift of the resonance mass. The mass distribution of the Δ's at the end of the collision process is solely determined by the available phase space, because the parameters applied in the model are those of the free resonance. An in-medium modification of the free Δ mass cannot be inferred because of the dominance of the kinematical effects and remaining systematic uncertainties of an absolute comparison of experiment and model. The explicit regardment only of the Δ degree of freedom in the applied model allows to detect by comparison of simulated mass spectra with the corresponding experimental distributions qualitatively contributions also of higher resonances. These are especially present in the $(p,\pi^-)$, but also in $(p,\pi^+)$ correlations. A resolution of the resonance structure is not possible, because the effective mass shift leads here to a broad energy distribution. (orig./HSI).

35273 (LBL–31125) **Dynamic-angle spinning and double rotation of quadrupolar nuclei.** Mueller, K.T. (Lawrence Berkeley Lab., CA (United States)). Lawrence Berkeley Lab., CA (United States). Jul 1991. 256p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000837. Source: OSTI; NTIS; INIS; GPO Dep.

Nuclear magnetic resonance (NMR) spectroscopy of quadrupolar nuclei is complicated by the coupling of the electric quadrupole moment of the nucleus to local variations in the electric field. The quadrupolar interaction is a useful source of information about local molecular structure in solids, but it tends to broaden resonance lines causing crowding and overlap in NMR spectra. Magic- angle spinning, which is routinely used to produce high resolution spectra of spin-$\frac{1}{2}$ nuclei like carbon-13 and silicon-29, is incapable of fully narrowing resonances from quadrupolar nuclei when anisotropic second-order quadrupolar interactions are present. Two new sample-spinning techniques are introduced here that completely average the second-order quadrupolar coupling. Narrow resonance lines are obtained and individual resonances from distinct nuclear sites are identified. In dynamic-angle spinning (DAS) a rotor containing a powdered sample is reoriented between discrete angles with respect to high magnetic field. Evolution under anisotropic interactions at the different angles cancels, leaving only the isotropic evolution of the spin system. In the second technique, double rotation (DOR), a small rotor spins within a larger rotor so that the sample traces out a complicated trajectory in space. The relative orientation of the rotors and the orientation of the larger rotor within the magnetic field are selected to average both first- and second-order anisotropic broadening. The theory of quadrupolar interactions, coherent averaging theory, and motional narrowing by sample reorientation are reviewed with emphasis on the chemical shift anisotropy and second-order quadrupolar interactions experienced by half-odd integer spin quadrupolar nuclei. The DAS and DOR techniques are introduced and illustrated with application to common quadrupolar systems such as sodium-23 and oxygen-17 nuclei in solids.

## 6514 Nuclear Properties and Reactions, A = 20-38, Experimental

*Refer also to citation(s) 35286*

35274 (BNL–44911, pp. 1-15) **Global observables in Si + nucleus collisions at 14.6 GeV per nucleon.** Shivakumar, B. (Yale Univ., New Haven, CT (USA)); Greene, S.V.; Hemmick, T.K.; Majka, R.; Mitchell, J.T.; Rotondo, F.; Sandweiss, J.; Barrette, J.; Mark, S.K.; Pruneau, C.; Bellwied, R.; Braun-Munzinger, P.; David, G.; Herrmann, N.; Ingold, G.; Llope, W.J.Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

A simultaneous determination of the transverse energy produced, and the multiplicity of beam rapidity nucleons surviving nucleus interactions provides an effective way to quantify the extent of stopping achieved therein. The authors have studied collisions between $^{28}$Si projectiles with energies $E_{lab}/A$ = 14.6 GeV and targets of Al, Cu, and Pb. Transverse energy production has been measured calorimetrically in a pseudorapidity interval $-0.5 < \eta < 0.8$, and correlated with the multiplicity of beam rapidity protons and neutrons detected in a 0.8° cone centered on the beam direction. Theoretical calculations have been performed to describe the data, and demonstrate quantitatively the large amount of nuclear stopping in these collisions. They also indicate the importance of rescattering in the production of transverse energy.

35275 (BNL–44911, pp. 16-26) **Charged particle multiplicity in relativistic heavy-ion collisions.** Hall, J.R. (Univ. of New Mexico, Albuquerque (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

What follows is a brief overview of the E814 silicon multiplicity detector and some of the data taken with it during a June 89 heavy ion physics run at the BNL AGS. The beam was 14.6 GeV/c/u $^{28}$Si on targets of Pb, Cu, and Al. For the data presented below all of the target thicknesses were 1.2% of a Si interaction length. All of the data shown below are still in analysis and none are final.

35276 (BNL–44911, pp. 38-43) **Charged particle distributions in heavy ion collisions at 14.6 GeV A/c.** Videbaek, F. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The Brookhaven experiment E-802 has several detectors to study global event characterization. These are the Zero Degree Calorimeter (ZCAL), a Lead Glass Array to study neutral energy emission, and a charged particle target multiplicity array (TMA). All of these can be used to characterize central events, but each measures different aspects of the collision. This report is concerned with results from the TMA. Data on charged particle distributions from reactions with Si and O projectiles on targets of Al, Cu, Ag, and Au are presented. Systematic features of the pseudorapidity distributions are discussed.

35277 (BNL–44911, pp. 44-69) **$E_T$ distributions, nuclear stopping, and correlations among measurements from the 4 detector systems in AGS E802.** Tannenbaum, M.J. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The E802 experiment contains four detector systems: a magnetic spectrometer with good particle identification over the momentum range $0.5 \leq p \leq 4.7$ GeV/c; a zero degree calorimeter (ZCAL) for detecting the forward energy, $E_F$, remnants of the projectile after an interaction: a target multiplicity array (TMA) for measurements of charged particles over the full phase space; and a highly segmented lead glass array (PbGl) for measurements of neutral energy flow and relativistic particle production in the central region of rapidity. Much can be learned from the study of the correlation of measurements in these 4 detectors. Experimental data is given and correlated for $^{28}S$, $^{16}O$ and protons on various targets.

35278 (BNL–44911, pp. 182-192) **First observation of $\Lambda^0$, $\bar{\Lambda}^0$, $K_s^0$ production in relativistic heavy ion collisions at the AGS.** Hallman, T. (Johns Hopkins Univ., Baltimore, MD (USA)); Madansky, L.; Welsh, R.; Bonner, B.E.; Krishna, N.; Kruk, J.; Mutchler, G.S.; Nessi, M.; Nessi-Tedaldi, F.; Tonse, S.; Eiseman, S.E.; Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Longacre, R.S.; Love, W.Brookhaven National Lab., Upton, NY (United States). [1990]. DOE Contract AC02-83ER40107 ;AS05-81ER40032 ;AC02-76ER03274. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

A topic presently of considerable discussion is the character and evolution of the hot, dense matter thought to be formed when relativistic nuclei undergo catastrophic central collisions. The concentration of strange matter in such reactions is of some interest in this regard. Were a plasma of quarks and gluons formed, one might expect to observe a substantial increase in the concentration of strange matter, as a consequence of Pauli-blocking of u, d, quark production. The authors report here the first observation of inclusive $\Lambda^0$, $\bar{\Lambda}^0$, $K_s^0$ production in nucleus-nucleus collisions at 14.5 GeV/n.

35279 (IAEA-TECDOC–572, pp. 145-175) **Results of CJD calculations on the REAL-88 project.** Zolotarev, K.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Pashchenko, A.B.; Pronyaev, V.G. International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

Calculation results of the rates of radiation damage in iron for the ANO, U-235, CFRMF, PS1 and PS2 neutron spectra unfolded by the measured reaction rates by means of the STAYSL code are presented. The cross-section files ZACRSS and BOSPOR, being developed in the USSR for neutron metrology are discussed. In the ENDF/B format the results of new evaluation of neutron radiation capture cross-sections for the $^{23}Na$, $^{37}Cl$, $^{55}Mn$, $^{63}Cu$, $^{139}La$ and $^{186}W$ isotopes are presented. (author). 63 refs, 9 figs, 6 tabs.

## 6515 Nuclear Properties and Reactions, A = 39-58, Experimental

*Refer also to citation(s) 35279*

## 6516 Nuclear Properties and Reactions, A = 59-89, Experimental

*Refer also to citation(s) 35194, 35274, 35275, 35276, 35277, 35279*

## 6517 Nuclear Properties and Reactions, A = 90-149, Experimental

*Refer also to citation(s) 35271, 35272, 35276, 35277, 35279*

35280 (GSI–91-31(prepr.)) **Gamow-Teller beta decay of the very neutron-deficient N=50 nuclide $^{98}Cd$.** Plochocki, A. (Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej); Rykaczewski, K.; Batsch, T.; Szerypo, J.; Zylicz, J.; Gabelmann, H.; Hill, P.; Ravn, H.; Thorsteinsen, T.; Grant, I.S.; Grawe, H.; Manakos, P. ISOLDE Collaboration. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jun 1991. 26p. Order Number DE92714424. Source: OSTI; NTIS (US Sales Only); INIS.

For the first time, detailed decay-spectroscopic investigations were performed for the very neutron-deficient N=50 nuclide $^{98}Cd$. The $^{98}Cd$ activity was produced in spallation reactions between 600 MeV protons and a natural tin target, yielding a $^{98}Cd$ beam intensity of 10 to 60 atoms per second at the collector of the ISOLDE mass-separator. By means of $\gamma$-ray and conversion-electron spectroscopy, 19 transitions were found to follow the $\beta^+$/EC decay $^{98}Cd \rightarrow {}^{98}Ag$. The transitions at 61 and 107 keV were shown to be M1(+E2) and E2, respectively, and the $^{98}Cd$ half-life was measured as $9.2 \pm 0.3$ s. The $Q_{EC}$ value of $^{98}Cd$ is determined semiempirically and is compared to model predictions together with the measured $Q_{EC}$ values of the N=50 isotones $^{92}Mo$, $^{94}Ru$, and $^{96}Pd$ taken from the literature. The newly established decay scheme of $^{98}Cd$ includes 9 excited states of $^{98}Ag$. Four states at 1691, 1861, 2164, and 2544 keV are directly fed by $0^+ \rightarrow 1^+$ Gamow-Teller beta transitions with a summed strength of $3.5_{-0.7}^{+0.8}$. This value corresponds to $25 \pm 5\%$ of the strength predicted for the GT transformation of a $g_{9/2}$ proton (in $^{98}Cd$) into a $g_{7/2}$ neutron (in $^{98}Ag$) by the extreme single-particle shell model with pairing. The GT-strength splitting and quenching, observed for $^{98}Cd$, are compared with the corresponding data for lighter even-even N=50 isotones, and are discussed with reference to the predictions of more sophisticated nuclear models. Within the framework to the shell-model, we find that it is possible to explain qualitatively the observed GT strength distribution and its total magnitude without renormalizing the free-neutron value of the axial-vector coupling constant. (orig.).

## 6518 Nuclear Properties and Reactions, A = 150-189, Experimental

*Refer also to citation(s) 35277, 35279*

35281 (ANL/CP–72878) **Superdeformed nuclei.** Janssens, R.V.F.; Khoo, Teng Lek. Argonne National Lab., IL (United States). [1991]. 43p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9109278–1: International Joliot-Curie summer school of nuclear physics, Maubuissen (France), 16-21 Sep 1991). Order Number DE92000269. Source: OSTI; NTIS; INIS; GPO Dep.

This paper reviews the most recent advances in the understanding of the physics of superdeformed nuclei from the point of view of the experimentalists. It covers among other subjects the following topics: (1) the discovery of a new region of superdeformed nuclei near A=190, (2) the surprising result of the occurrence of bands with identical transition energies in neighboring superdeformed nuclei near A=150 and A=190, (3) the importance of octupole degrees of freedom at large deformation and (4) the properties associated with the feeding and the decay of superdeformed bands. The text presented hereafter will appear as a contribution to the Annual Review of Nuclear and Particle Science, Volume 41. 88 refs., 11 figs.

35282 (JINR-R–6-89-881) **$H_{11/2}$ and $s_{1/2}$ isomeric states in $^{155}Tm$.** Potempa, A.V. (and others); Afanas'ev, V.P.; Vavryshchuk, Ya. Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems. 1989. 6p. (In Russian). Order Number DE92600689. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the Conference on Nuclear Spectroscopy and Atomic Nucleus Shape, Leningrad (SU), Apr 1990 and to the journal Izv. Akad. Nauk SSSR, Ser. Fiz.

The alpha decay of $^{155}Tm$ on experimental sets for studying nuclei far from beta-stability line - YaSNAPP-2 has been investigated. Two components of $^{155}Tm$ $\alpha$ decay disintegration curve with $T_{1/2}$ = 23(3) s and $T_{1/2}$ 47(6) s for $E_\alpha$ = 4462 keV have been observed. It is concluded that the ground state of $^{155}Tm$ has spin and parity $11/2^-$ and $T_{1/2}$ = 23(3) s and isomeric one with 41(6) keV - $1/2^+$ and $T_{1/2}$ = 47(6) s. $b_\alpha$ $N_\alpha/N_\alpha + N_\beta$ values for $\alpha$ decay of

$^{155}$Tm and $^{151}$Ho are obtained notably: $b_\alpha(^{155}Tm)$ = 0.012(6) and $b_\alpha(^{151}Ho)$ 0.47(8). 18 refs.; 3 figs.

## 6519 Nuclear Properties and Reactions, A = 190-219, Experimental

*Refer also to citation(s) 35194, 35270, 35271, 35272, 35274, 35275, 35276, 35281*

**35283** (BNL–44911, pp. 27-37) **AGS silicon gold collisions measured in the E-810 TPC.** Love, W.A. (Brookhaven National Lab., Upton, NY (USA)); Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Longacre, R.S.; Morris, T.W.; Platner, E.D.; Saulys, A.C.; Bonner, B.E.; Buchanan, J.A.; Chiou, C.N.; Clement, J.M.; Corcoran, M.D.; Kruk, J.W.; Miettinen, H.Brookhaven National Lab., Upton, NY (United States). [1990]. DOE Contract AC02-83ER40107 ;AS05-81ER40032 ;AC02-76ER03274. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The tracking detector of AGS Experiment 810 is a three-piece Time Projection Chamber (TPC) intended to measure all charged tracks in the forward hemisphere of the nucleon-nucleon center of mass system, i.e. forward of an angle of about 20 degrees in the lab. Each module of the TPC contains twelve rows of short anode wires which give 3-D space points on each track, but no dE/dx information useable for particle identification. The TPC was operated in a beam of silicon ions at the end of June 1989 and this talk reports the results of analysis of the data taken with a thin gold target in that run. The authors have gathered a similar amount of data from thin copper and silicon targets, the analysis of which is in a less advanced state. The results of the investigation of the neutral strange particle decays appear in a separate contribution by Al Saulys. This paper presents the current state of the analysis of the charged tracks from the silicon gold collisions.

**35284** (BNL–44911, pp. 193-208) **Baryon spectra in the low $p_T$-region.** Bellwied, R. (State Univ. of New York, Stony Brook (USA)); Braun-Munzinger, P.; David, G.; Herrmann, N.; Ingold, G.; Llope, W.J.; Muthuswami, M.; Stachel, J.; Waters, L.; Barrette, J.; Mark, S.K.; Pruneau, C.; Cleland, W.; Jayananda, K.; Kraus, D.; SonnadaBrookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The measurement of transverse momentum spectra for identified particle species in central collisions of relativistic heavy ions is of great interest for the determination of parameters which describe the phase of high density matter presumably formed in these collisions. If thermal equilibrium is reached in a heavy ion collision, then the transverse momentum distribution of the emitted particles is related to the freeze-out temperature T of the particle species under consideration. For a single source Boltzmann-distribution T would be obtained, e.g., by fitting a distribution of the form $A\ m_T \exp(-m_T/T)$ to the measured transverse momentum spectrum, where $m_T = \sqrt{m_0^2 + p_T^2}$. In this contribution the authors show first results for neutron spectra for $E_{lab}/A$ = 14.6 GeV Si + Pb collisions in the $p_T$-range 0-250 MeV/c for a rapidity range y = 2-3.85. Neutrons are identified by the measurement of their energy deposit and time-of-flight measured in the U/Cu/Sc calorimeter modules of the forward spectrometer. The performance of these calorimeters is described in detail. The kinetic energy, as well as the x- and the y-position of single isolated neutrons is obtained by reconstructing clusters using a pattern-recognition algorithm. Charged particles are identified by their signal in the scintillator wall in front of the calorimeters and rejected from the sample. Other possible contaminations in the neutron spectra are decay gamma rays from $\pi^0$'s generated in the reaction and background (secondary neutrons and gammas) generated by particles interacting in the steel of the spectrometer magnets. Monte Carlo studies and comparison with preliminary spectra obtained for protons indicate that this background is completely negligible for neutron rapidities $y \geq 2.5$ and is estimated to be less than 15% in the lowest rapidity bin.

**35285** (BNL–44911, pp. 209-226) **$V^0$ production with 14.5 GeV/c silicon beams.** Saulys, A.C. (Brookhaven National Lab., Upton, NY (USA)); Etkin, A.; Foley, K.J.; Hackenburg, R.W.; Longacre, R.S.; Love, W.A.; Morris, T.W.; Platner, E.D.; Bonner, B.E.; Buchanan, J.A.; Chiou, C.N.; Clement, J.M.; Corcoran, M.D.; Kruk, J.W.; Miettinen, H.Brookhaven National Lab., Upton, NY (United States). [1990]. DOE Contract AC02-83ER40107 ;AS05-81ER40032 ;AC02-76ER03274. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

This talk deals with $\Lambda$, $K_s^0$ and $\bar{\Lambda}$ production with 14.5 GeV/c silicon beams. Why study $V^0$ production? Because the study of strangeness is an important part of the search for Quark Gluon Plasma (QGP). Many models predict an enhancement of strangeness in a QGP as compared to the amount of strangeness produced in a superposition of nucleon-nucleon interactions. The amount of enhancement varies from model to model. Even if no QGP is detected at AGS energies using Si beams, it is important to understand the production mechanisms in quantitative detail so that standard nucleon-nucleon production mechanism can be distinguished from QGP formation. The advantage of measuring strangeness production by measuring $V^0$ production is that $V^0$'s can be identified by kinematics without the use of any special particle ID detectors. The disadvantage is that usually large aperture detectors are required. Experiment 810 has the needed large aperture. This talk describes the technique and results of $V^0$ production from $\sim$ 9,000 interactions of Si in a 1 mil (25 micron) Au target recorded in June, 1989.

**35286** (BNL–44911, pp. 402-410) **E802 HBT results.** Morse, R.J. (Massachusetts Inst. of Tech., Cambridge (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

In the past, the technique of second-order intensity interferometry has been used in order to infer the space-time structure of hadron-hadron and nucleus-nucleus reactions. In the latter case, the observation has been that the measured source size scales with the projectile size. The E802 spectrometer at the Brookhaven AGS has been used in order to obtain two-particle inclusive pion distributions from E/A = 14.6 GeV $^{28}$Si + $^{197}$Au and $^{27}$Al collisions near midrapidity for the nucleon-nucleon system. The author presents preliminary results for the source sizes and lifetimes obtained by fitting the two-particle correlation function.

**35287** (KFK–4870) **Measurements of the Coulomb dissociation cross section of 156 MeV $^6$Li projectiles at extremely low relative fragment energies of astrophysical interest.** Kiener, J. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Kernphysik); Gils, H.J.; Rebel, H.; Zagromski, S.; Gsottschneider, G.; Heide, N.; Jelitto, H.; Wentz, J.; Baur, G. Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Kernphysik. Apr 1991. 47p. Order Number DE92711168. Source: OSTI; NTIS (US Sales Only); INIS.

Coulomb dissociation of light nuclear projectiles in the electric field of heavy target nuclei has been experimentally investigated as an alternative access to radiative capture cross sections at low relative energies of the fragments, which are of astrophysical interest. As a pilot experiment the breakup of 156 MeV $^6$Li-projectiles at $^{208}$Pb with small emission angles of the a particle and deuteron fragments has been studied. Both fragments were coincidentally detected in the focal plane of a magnetic spectrograph at several reaction angles well below the grazing angle and with relative angles between the fragments of 0deg-2deg. The experimental cross sections have been analyzed on the basis of the Coulomb breakup

theory. The results for the resonant breakup give evidence for the strong dominance of the Coulomb dissociation mechanism and the absence of nuclear distortions, while the cross section for the non-resonant breakup follow theoretical predictions of the astrophysical S-factor and extrapolations of corresponding radiative capture reaction cross section to very low c. m. energies of the a particle and deuterons. Various implications of the approach are discussed. (orig.).

## 6520 Nuclear Properties and Reactions, A = 220 and Above, Experimental

**35288** (GSI–91-32(prepr.)) **The new nuclide $^{263}$Ha.** Kratz, J.V. (Mainz Univ. (Germany, F.R.). Inst. fuer Kernchemie); Gober, M.K.; Zimmermann, H.P.; Gregorich, K.E.; Tuerler, A.; Hannink, N.J.; Czerwinski, K.R.; Kadkhodayan, B.; Lee, D.M.; Nurmia, M.J.; Hoffman, D.C.; Gaeggeler, H.; Jost, D.; Kovacs, J.; ScGesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jun 1991. 19p. Contract BMFT 03HE2MAI;DE-AC030-76SF00098. Order Number DE92714427. Source: OSTI; NTIS (US Sales Only); INIS.

A new nuclide $^{263}$Ha was produced in the bombardment of a $^{249}$Bk target with 93-MeV $^{18}$O ions. It was detected via spontaneous fission counting and was shown to have a half-life of about 0.5 min. This activity was also separated from the reaction products by automated rapid chemical separations using cation-exchange chromatography in 0.05 M $\alpha$-hydroxyisobutyric acid. After chemical separation, $^{263}$Ha was found to decay by spontaneous fission ($57_{-15}^{+13}$%) and by alpha-emission ($E_\alpha$=8.35 MeV, 43%) with a half-life of $27_{-7}^{+10}$ s. The spontaneous fission fragment energy spectrum is compatible with an average total kinetic energy of about 200 MeV. (orig.).

## 6530 Nuclear Theory

*Refer also to citation(s) 35232, 35253, 35254, 35260, 35261, 35265, 35266, 35273, 35274, 35277, 35281, 35443, 35444*

**35289** (ANL/CP–74237) **Variational Monte Carlo calculations of finite nuclei.** Wiringa, R.B. Argonne National Lab., IL (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-9108142–2: Recent progress in many-body theories, Minneapolis, MN (United States), 26-31 Aug 1991). Order Number DE91018895. Source: OSTI; NTIS; INIS; GPO Dep.

A major goal in nuclear physics is to understand how nuclear structure comes about from the underlying interactions between nucleons. This requires modelling nuclei as collections of strongly interacting particles. Using realistic nucleon-nucleon potentials, supplemented with consistent three-nucleon potentials and two-body electroweak current operators, we calculate nuclear ground-state properties, such as the binding energy, electromagnetic form factors, and momentum distributions. Other properties such as excited states and low-energy reactions are also calculable in this framework. 22 refs., 5 figs., 4 tabs.

**35290** (BNL–44911, pp. 102-115) **What do we learn from transverse energy distributions?.** Baym, G. (Univ. of Illinois, Urbana (USA)); Friedman, G.; Heiselberg, H. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

Transverse energy measurements provide a wealth of information on the physics of ultrarelativistic heavy-ion collisions. To begin with they tell one the degree to which the colliding nuclei transfer energy and stop each other. With information about the space-time dynamics of the collisions, transverse energy data enables one to estimate the evolving energy density in the collision volume, a quantity needed to assess the likelihood of quark-gluon plasma formation. Furthermore, since the transverse energy distribution is to a large extent determined by the geometry of the collision, transverse energy is a useful indicator of centrality of collisions. It also provides considerable evidence for the rescattering of secondaries in the medium. Finally, fluctuations in the tails of the transverse energy distributions are an important probe of the independence of or possible coherence among the nucleon-nucleon subcollisions that constitute the first stage of heavy-ion collisions. Since the experimental talks in this workshop have done a rather complete job of presenting the transverse energy data from both BNL and CERN, the focus, as the authors discuss these topics in turn, will be on the theoretical interpretation of the data.

**35291** (BNL–44911, pp. 116-133) **Comparison of string models for heavy ion collisions.** Werner, K. (CERN, Geneva (Switzerland)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

An important method to explore new domains in physics is to compare new results with extrapolations from known areas. For heavy ion collision this can be done with string models, which extrapolate from light to heavy systems and which also may be used to extrapolate to higher energies. That does not mean that these string models are only background models, one may easily implement new ideas on top of the known aspects, providing much more reliable models than those formed from scratch. All the models to be considered in this paper have in common that they consist of three independent building blocks: (a) geometry, (b) string formation and (c) string fragmentation. The geometry aspect is treated quite similar in all models: nucleons are distributed inside each nucleus according to some standard parameterization of nuclear densities. The nuclei move through each other on a straight line trajectory, with all the nucleon positions being fixed. Whenever a projectile and a target nucleon come close, they interact. Such an interaction results in string formation. In the last step these strings decay into observable hadrons according to some string fragmentation procedure. The three building blocks are independent, so one can combine different methods in an arbitrary manner. Therefore rather than treating the models one after the other, the author discusses the procedures for string formation and string fragmentation as used by the models. He considers string models in a very general sense, so he includes models where the authors never use the word string, but which may be most naturally interpreted as string models and show strong similarities with real string models. Although very important he does not discuss - for time and space reasons - recent developments concerning secondary scattering.

**35292** (BNL–44911, pp. 134-143) **Secondary interactions in HIJET.** Longacre, R.S. Brookhaven National Lab., Upton, NY (United States). [1990]. DOE Contract AC02-83ER40107 ;AS05-81ER40032 ;AC02-76ER03274. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

This talk deals with the investigation of secondary interactions in proton-nucleus and nucleus-nucleus collisions using the Monte Carlo event generator HIJET. The HIJET generator considers p-A and A-A collisions to be a sum of independent N-N collisions, with the N-N cross section and scattering dynamics not dependent on whether the nucleon has previously participated in an interaction. It is very reasonable to assume that each collision should be well represented by an independent N-N collision, however the cross section for the forward going struck nucleon may be different. For each primary N-N interaction, a call is made to the MINBIAS routine of the program ISAJET - an event generator for high energy N-N interactions. MINBIAS computes the energy loss of the colliding nucleons and production of particles. MINBIAS is based on inclusive high energy N-N interactions forming multi-pomeron chains, with each chain fragmenting according to the Field-Feynman algorithm.

**35293** (BNL–44911, pp. 144-153) **Formation and break-up of hadronic fireballs.** Stachel, J. (State Univ. of New York, Stony Brook (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics

at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

Experimental data presently available for beam energies of 14.6 to 200 GeV/nucleon support the picture of a large degree of nuclear stopping that forms the basis of fireball models. While the data clearly exclude the picture of a system emitting particles isotropically, many of the experimental features are in line with predictions from the Landau model. To what extent this indicates the formation of a thermalized system in such relativistic heavy ion collisions is unclear at present. While the amount of experimental data available has grown very much, there are still missing links. At present, the systematics of transverse momentum spectra is not understood well enough to distinguish between the various theoretical conjectures made in the literature. It is still not known to what extent slopes of $p_t$ spectra reflect the temperature of a system at all. One alternative test would be to measure excited state populations of e.g. the nucleon, by determining for instance the abundance thermalization and stopping are nucleon rapidity distributions. There, experimental measurements over the full range of rapidities and as large a $p_t$ range as possible are needed. In particular, to sort out the question of rescattering effects, comparison to symmetric target-projectile combinations is needed. While obviously not all of the observed experimental features are as expected based on the, admittedly very much simplified, assumptions of a thermal model present data certainly do not rule out such a scenario.

**35294** (BNL–44911, pp. 154-175) **Hydrodynamical analysis of transverse momentum distributions in ultrarelativistic heavy ion collisions.** von Gersdorff, H. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The transverse momentum ($p_T$) distributions of the secondaries produced in high energy heavy ion collisions may be sensitive to the collective fluid flow of the hot hadronic matter initially produced by the colliding nuclei. Recently these distributions have been measured at BNL and CERN, so that a comparison with theoretical models is now possible. In this paper the author calculates these distributions from a longitudinal boost invariant transverse hydrodynamical model which has a deconfining phase transition incorporated in the equation of state. Essentially, this is done by solving numerically the transverse hydrodynamical equations, coupling them with the exact longitudinal scaling solutions and thereby obtaining the evolution of the matter's energy and velocity profile. From these one can calculate the decoupling surface where the matter reaches $T_{dec}$ (the decoupling temperature ~140 MeV) at which point he assumes the system breaks up instantly into free streaming hadrons. Once he knows the space-time location of the decoupling surface and the collective fluid velocity (or rapidity) of the matter on this surface, the calculation (essentially an integral of Bose-Einstein or Fermi-Dirac distributions) of the transverse momentum distribution of the emitted particles can be performed and a comparison with experiment can then be done. The hope is that these $p_T$ distributions are sensitive to the thermal and collective nature of the expanding matter.

**35295** (BNL–44911, pp. 176-181) **Scaling in fragmentation of target spectators.** Csoergo, T. (Central Research Inst. for Physics, Budapest (Hungary)); Zimanyi, J. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The LUND string picture is a remarkably successful phenomenological description of high energy hadronization processes, occurring in jet events. The FRITIOF model is a combination of the soft collisions occurring in high energy hadron-hadron, hadron-nucleus and nucleus-nucleus collisions, followed by string fragmentation. FRITIOF and also other models for hadronic interaction which try to describe experimental observables as a superposition of nucleon-nucleon collisions describe the pseudorapidity distributions measured in emulsion experiments well, where the angular distribution of relativistic shower particles are measured. However they fail to describe the pseudorapidity distribution of charged particles at target fragmentation and midrapidity. The authors have shown that the FRITIOF model for soft hadronic processes combined with a moving thermal source for target spectator fragmentation describes the measured pseudorapidity distributions of produced hadrons at 14.5 AGeV within 10% error as well as at 60 and 200 AGeV for different targets and $O^{16}$ projectiles. Their model explains why the measured baryon pseudorapidity distributions were proportional for central 60 and 200 AGeV $O^{16}$+B collisions in the target fragmentation region. They are thermal distributions with $T \approx 66$ MeV, moving with $u \approx 0.3c$. They emphasize that the pseudorapidity distribution of the spectators given peaks at $\eta \approx 0.5$ for $b \approx 0.6$ thus the contribution of spectator fragments is not negligible for pseudorapidity $\eta \leq 1.5$.

**35296** (BNL–44911, pp. 295-299) **Shape of pion $p_T$-spectra.** Ruuskanen, P.V. (Univ. of Jyvaeskylae (Finland)); Kataja, M. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

If the pions which are observed in the recent heavy-ion experiments at CERN and Brookhaven are extrapolated backwards close to the collision time, one finds densities which are clearly above the thermal densities at the transition temperature, commonly estimated to be of order 200 MeV. One can obtain such a high density of quanta in several ways. The authors would like to convince themselves that the observed increase of quanta is due to the phase transition to quark-gluon plasma (QGP) with roughly 10 times the number of pionic degrees of freedom. Higher density can also be achieved raising the temperature. At $T \simeq 320$ MeV, pions reach the density 1.2 $fm^{-3}$. It is not completely ruled out that such a state of overheated pion gas could be formed in the collision process. In a static situation, they believe, e.g. from lattice calculations, that QGP is the stable state at such a temperature. In the short production time and rapid initial expansion this static argument is not necessarily applicable. However, all calculations starting from an initial state of such a high temperature lead to $p_T$-distributions which are much wider than the observed ones. At the presently observed densities another quite plausible possibility - instead of strong heating of pions over the transition temperature - is the formation of dense pion gas far from chemical equilibrium. As has been pointed out earlier, the expanding gas of massive pions will fall off the chemical equilibrium as a result of the small rate of pion number reducing reactions. They have performed numerical calculations of this effect by assuming conservation of pion number and using the equation of state of free gas of massive pions. Even though the increase of chemical potential from zero is considerable (up to 100 MeV), it does not seem to lead to values which are close enough to the mass to change the shape of the spectrum.

**35297** (BNL–44911, pp. 314-317) **Dilepton production theory.** Kapusta, J. (Univ. of Minnesota, Minneapolis (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. DOE Contract FG02-87ER40328. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

Whenever charged particles collide they radiate real and virtual photons, the virtual ones decaying into lepton pairs. The advantage of observing electromagnetic signals from a strongly interacting many-body system is that they travel relatively unscathed from the production point to the detector. Since production rates are rapidly increasing functions of temperature and density these electromagnetic signals are good probes of the early high temperature and density stage of heavy ion collisions. The purpose of this talk is to

provide an exploratory study of electron-positron radiation from finite temperature and density nuclear matter, and to make some corresponding comparisons with the p(4.9 GeV) + Be measurements of the DLS group.

**35298** (BNL–44911, pp. 344-360) **Energy density, stopping and flow in ultrarelativistic heavy ion collisions.** Sorge, H. (Johann Wolfgang Geothe Univ. Frankfurt am Main (West Germany)); von Keitz, A.; Mattiello, R.; Stoecker, H.; Greiner, W. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The Lorentz invariant molecular dynamics approach (RQMD) is employed to investigate the space-time evolution of heavy ion collisions at energies ($E_{kin}$ = 10AGeV···200AGeV). The calculations for various nucleus nucleus reactions show a high degree of stopping power. The importance of secondary rescattering at these beam energies is demonstrated. The computed nucleon rapidity distributions are compared to available experimental data. It is demonstrated that nonlinear, collective effects like full stopping of target and projectile and matter flow could be expected for heavy projectiles only. For nuclear collisions in the Booster era at BNL and for the lead beam at CERN SPS the authors predict a stimulating future: then a nearly equilibrated, long lived (8 fm/c) macroscopic volume of very high energy density (> 1 GeV/fm$^3$) and baryon density (> 5 times ground state density) is produced.

**35299** (BNL–44911, pp. 361-370) **Kaon enhancement as an evidence for chiral restoration in hot dense nuclear matter formed in heavy-ion collisions.** Ko, C.M. (Texas A and M Univ., College Station (USA)); Wu, Z.G.; Xia, L.H.; Brown, G.E. Brookhaven National Lab., Upton, NY (United States). [1990]. DOE Contract FG02-88ER40388. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

Kaon production from meson-meson annihilation is enhanced significantly if the hadron masses are reduced in hot dense nuclear matter as a result of the restoration of chiral symmetry. In an expanding fireball model for heavy-ion collisions, the authors demonstrate that the observed enhancement of kaon yield in high energy heavy-ion collisions can be explained by this effect.

**35300** (BNL–44911, pp. 371-383) **Spectra of secondary particles from nuclear collisions at ultrarelativistic energies.** Prakash, M. (State Univ. of New York, Stony Brook (USA)). Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

The rapidity and/or pseudorapidity spectra of pions produced in nuclear collisions at beam energies of 14.5, 60 and 200 GeV are fit well by gaussian distributions. The many attempts to model ultrarelativistic collisions can be broadly classified into two groups: (i) hydrodynamic models, and (ii) sequential scattering models. Typical examples of the first category are the Landau-Milekhin approach at one extreme and the Bjorken approach at the other. The Lund model based on string dynamics exemplifies the second category. Both of these approaches roughly reproduce the essential features of the rapidity spectra. Whether the similarities of the final results from these two different approaches is due to the smooth behavior of multi-particle final states alone or whether the two approaches are related at a deeper level is a topic presently under scrutiny. Some vexing questions remain for both models. Two examples of these in the hydrodynamic model are the a priori justification of local equilibrium and the appropriateness of boundary conditions. In the string picture, on the other hand, interactions between the strings remain to be included. Here the author entertains the idea that hydrodynamics is applicable and discusses the predictions of the Landau model. Curiously, the discourse regarding the interpretation of the rapidity spectra in the Landau model is somewhat confusing, given its apparent simplicity. He discusses how one might draw erroneous conclusions regarding the predictions of the rapidity spectra as well as the quality of fits predicted by the model. He discusses concurrently how Milekhin's reformulation of Landau's original model makes predictions about these spectra which are potentially interesting.

**35301** (BNL–44911, pp. 459-502) **Physics of the pion liquid.** Shuryak, E.V. Brookhaven National Lab., Upton, NY (United States). [1990]. (CONF-900331–: Workshop on heavy ion physics at the alternating gradient synchrotron (HIPAGS), Upton, NY (United States), 3-7 Mar 1990). In *Proceedings of the workshop on heavy ion physics at the Alternating Gradient Synchrotron (AGS).* 512p. Order Number DE90017639. Source: OSTI; INIS; NTIS.

Excited hadronic matter in the temperature interval T = 100-200 MeV is not an ideal pion gas, but ratehr a liquid, in which attractive interaction among particles plays an important role. Pion dispersion curve is in this case essentially modified by a kind of collective momentum-dependent potential, which becomes important as the quasipion comes to the boundary of the system. The author shows that these effects can provide an explanation for a number of recent experimental puzzles, in particular, for the observed copious production of soft pions and soft photons in high energy hadronic reactions.

**35302** (BONN-ME–91-01) **Photoproduction of charged and neutral pions in nuclei in the Δ-resonance region.** Arends, J. Bonn Univ. (Germany). Physikalisches Inst. Jul 1991. 12p. (CONF-9106194–: International workshop on pions in nuclei, Penyscola (Spain), 2-9 Jun 1991). Order Number DE92714446. Source: OSTI; NTIS (US Sales Only); INIS.

Photonuclear reactions induced by tagged photons in the energy range around the Δ-resonance are discussed. The total hadronic photoabsorption cross section ($\sigma_\gamma^{tot}$) shows a clear evidence for Δ-excitation in nuclei with a universal behaviour for a wide range of nuclear mass numbers. Next, the partitioning into specific reaction channels is studied. The dominant reaction mechanisms are pion production and γ-absorption on a correlated nucleon pair (quasi-deuteron effect), which are clearly visible in inclusive pion and proton energy spectra from light nuclei. The A-dependences of $\sigma_\gamma^{tot}$ and the emission of pions and protons are compared. Whereas pions are strongly absorbed in heavy nuclei, the emission of protons is enhanced, supporting the picture of a two-step γ-absorption mechanism (volume π-production followed by π-absorption). (orig.).

**35303** (CONF-9010183–5) **Inclusive quasielastic and deep inelastic electron scattering at high energies.** Day, D.B. Virginia Univ., Charlottesville, VA (United States). Inst. of Nuclear and Particle Physics. [1990]. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-86ER40261. From European workshop on hadronic physics with electrons beyond 10 GeV; Dourdan (France); 8-12 Oct 1990. Order Number DE91018755. Source: OSTI; NTIS; INIS; GPO Dep.

With high electron energies a kinematic regime can be reached where it will be possible to separate quasielastic and deep inelastic scattering. We present a short description of these processes which dominate the inclusive spectrum. Using the highest momentum transfer data available to guide our estimates, we give the kinematic requirements and the cross sections expected. These results indicate that inclusive scattering at high q has a yet unfilled potential. 18 refs., 13 figs.

**35304** (DOE/ER/40335–6) **[Theoretical nuclear physics]: Progress report, October 1, 1990–October 1, 1991.** Colorado Univ., Boulder, CO (United States). Dept. of Physics. [1991]. 41p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER40335. Order Number DE92000022. Source: OSTI; NTIS; INIS; GPO Dep.

This report discussed the following topics: Consistent RHA-RPA for finite nuclei; vacuum polarization in a finite system; isovector correlations in QHD description of nuclear matter; nuclear response

functions in quasielastic electron scattering; charge density differences for nuclei near $^{208}Pb$ in quantum hadro-dynamics; excitation of the 10.957 MeV $0^-$; T=0 state in $^{16}O$ by 400 MeV protons; deformed chiral nucleons; new basis for exact vacuum calculations in 3-spatial dimensions; second order processes in the (e,e'd) reaction; scalar and vector contributions to $\bar{p}p \rightarrow \bar{\Lambda}\Lambda$ and $\bar{p}p \rightarrow \bar{\Lambda}\Sigma^0$ + c.c; and radiative capture of protons by light nuclei at low energies.

**35305** (DOE/ER/40537–9) **Interplay between pion absorption and inclusive-inelastic scattering on hydrogen and helium isotopes for 96.5-MeV kinetic energy pions.** Storm, D.W. Washington Univ., Seattle, WA (United States). Dept. of Physics. [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG06-90ER40537. (CONF-9109291–1: 5. mesons and light nuclei, Prague (Czechoslovakia), 1-6 Sep 1991). Order Number DE92000825. Source: OSTI; NTIS; INIS; GPO Dep.

Measurements of double-differential cross sections for inclusive-inelastic scattering of 96.5-MeV pions from hydrogen and helium isotopes are presented. Differential and angle-integrated cross sections are obtained. Distorted wave impulse approximation calculations are reported. The interplay between inclusive-inelastic scattering and pion absorption is discussed. 13 refs., 5 figs., 1 tab.

**35306** (GSI–91-28(prepr.)) **Ultrarelativistic heavy-ion collisions and the formation of new particles.** Soff, G. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.)); Michelbach, W.; Hofmann, C.; Greiner, M.; Vidovic, M.; Best, C.; Schneider, S.; Hilberg, D. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jun 1991. 26p. Order Number DE92714434. Source: OSTI; NTIS (US Sales Only); INIS.

Implications of heavy-ion collisions at energies up to 10 TeV/u+10 TeV/u are investigated. In the following we discuss a few intriguing ideas concerning the exploration of ultrarelativistic nucleus-nucleus collisions. We indicate various phenomena which may help to extend our knowledge from planned investigations of elementary particle collisions at future supercolliders. (orig.).

**35307** (GSI–91-29(prepr.)) **Fermionic molecular dynamics for ground states and collisions of nuclei.** Feldmeier, H.; Bieler, K. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jun 1991. 12p. (CONF-910396–: 1. European biennial workshop on nuclear physics, Megeve (France), 25-29 Mar 1991). Order Number DE92714425. Source: OSTI; NTIS (US Sales Only); INIS.

Fermionic Molecular Dynamics has been proposed as an approximation scheme to solve the many-body problem of interacting identical fermions with spin 1/2. In this model the interacting system is represented by an antisymmetrized many-body wave function consisting of single-particle states which are localized in phase space. The equations of motion for the parameters characterizing the many-body state (e.g. positions, momenta and spins of the particles) are derived from a quantum variational principle. This contribution gives first results for ground states of nuclei and collisions between light nuclei. (orig.).

**35308** (INS–881) **Hypernuclear spectroscopy at a phi factory.** Yamazaki, Toshimitsu. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jun 1991. 6p. Order Number DE92704182. Source: OSTI; NTIS (US Sales Only); INIS.

The promising aspects of hypernuclear spectroscopy using stopped $K^-$ at a phi factory are discussed with special emphases on the various tagging capabilities. (author).

**35309** (KFTI–88-56) **Deuteron photo- and electrodisintegration in the Bethe-Salpeter formalism.** Korchin, A.Yu.; Shebeko, A.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1988. 23p. (In Russian). Order Number DE91643515. Source: OSTI; NTIS (US Sales Only); INIS.

Successive deviation of expression for the amplitude of $\gamma$d->pn (ed->e'pn), reaction in terms of Bethe-Salpeter (BS) amplitudes for initial and final states and electromagnetic Mandelstam current is suggested. It is shown that in BS formalism the SO called S-pole diagram, corresponding to intermediate deuteron, is the consequence of pole part separation in t-matrix of NN-scattering, satisfying BS equation.

**35310** (LA-UR–91-2922) **P-d capture reactions in muonic molecules.** Friar, J.L. Los Alamos National Lab., NM (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109122—2: 13. European conference on few-body problems in physics, Elba (Italy), 9-14 Sep 1991). Order Number DE92000256. Source: OSTI; NTIS; INIS; GPO Dep.

Capture reactions for very low-energy n-d and p-d systems are calculated and compared with experiment, as are low-energy n-d and p-d scattering. We find excellent agreement for the n-d scattering lengths, but poor agreement for the p-d case, which we believe is a problem with the experimental extrapolation. The n-d radiative capture is sensitive to details of the meson-exchange currents, but reasonable models agree with the data. The latter models are in good agreement with experiment when extended to the p-d case. Our large quartet capture rate resolves a long-standing anomaly. The EO capture matrix element recently obtained from a reanalysis of internal conversion in muonic molecules is in excellent agreement with our predictions. This matrix element is very clean theoretically and provides the best test of the calculations. 33 refs., 3 figs., 1 tab.

**35311** (LA-UR–91-2988) **Unitarity and pion production in relativistic heavy-ion collisions.** Liu, L.C. Los Alamos National Lab., NM (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9106194–7: International workshop on pions in nuclei, Penyscola (Spain), 2-9 Jun 1991). Order Number DE92000212. Source: OSTI; NTIS; INIS; GPO Dep.

Pion production in relativistic heavy-ion collisions is examined. It is shown that the commonly employed effective-velocity theory is incorrect. A formulation based on the unitarity is presented. 8 refs., 1 figs.

**35312** (SAND–91-2113C) **Neutron interactions and contrast production in neutron radiography.** McCrory, F.M. Sandia National Labs., Albuquerque, NM (United States). [1991]. 8p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-910952–1: Fall conference and 50th anniversary conference of the American Society for Nondestructive Testing, Boston, MA (United States), 15-18 Sep 1991). Order Number DE91019064. Source: OSTI; NTIS; INIS; GPO Dep.

The usefulness of neutron radiography as a nondestructive engineering tool is heavily dependent on how a neutron reaches the image plane. Neutron interactions such as scattering and absorption, within a neutron radiography facility or a test part, affect the contrast of the resulting image generated by the process. It is important that the radiographer has a general understanding of how neutrons interact with matter to produce a quality image utilizing a neutron beam. 4 refs.

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*Refer also to citation(s) 33828, 35527, 35559*

**35313** (DOE/ER/61064–1) **A research program on radiative transfer model development in support of the ARM program: Progress report No. 1, 15 September 1990–28 February 1991.** Clough, S.A. Atmospheric and Environmental Research, Inc., Cambridge, MA (United States). 1 Mar 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-90ER61064. Order Number DE91018869. Source: OSTI; NTIS; GPO Dep.

This report discusses radiative transfer model development in support of the ARM program. (LSP)

**35314** (EGG–1183-1432) **Selected HENRE measurements.** Jobst, J.E. EG and G, Inc., Las Vegas, NV (United States). 18 Apr 1969. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC08-76NV01183. Order Number DE91018217. Source: OSTI; NTIS; GPO Dep.

The acronym "HENRE" stands for high energy neutron reactions experiments. HENRE is a neutron generator operated by EG&G for the Civil Effects Branch, Division of Biology and Medicine, of the AEC. It is located on the Nevada Test Site, approximately 85 miles northwest of Las Vegas. HENRE is basically a linear accelerator mounted on a tower. The Civil Effects Test Operations (CETO) of

the Division of Biology and Medicine (DBM) of the US Atomic Energy Commission has operated HENRE on the Nevada Test Site for the past three years. This document provides a very brief summary of the data acquired in a large variety of field experiments. 9 figs.

**35315** (IAEA-TECDOC–572, pp. 133-137) **The role of the REAL-88 exercise in the radiation damage characterization of nuclear facilities.** Zsolnay, E.M. (Netherlands Energy Research Foundation, Petten (Netherlands)); Nolthenius, H.J.; Szondi, E.J. International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

In the frame of the REAL-88 project a reference file will be produced for neutron metrology use containing the best available input-output information for 6 typical neutron spectrum cases, furthermore, cross section processing codes and several utility programs. A number of reactions cannot be incorporated because no adequate cross section data are available. Discrepant cross section values, furthermore, clearly imperfect cross section uncertainty data were found in the IRDF-85 for several reactions. (author). 13 refs.

**35316** (IAEA-TECDOC–572, pp. 139-144) **Physically based weighting spectrum generation for cross section calculations.** Szondi, E.J. (Technical Univ. of Budapest (Hungary). Inst. of Nuclear Techniques); Bosznay, A.P. International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

For collapsing the cross section data into a coarse group structure one needs a continuous weighting neutron spectrum. This spectrum is known in the coarse structure. The newly developed procedure for converting the spectrum into the 640 group SAND II structure takes into account the few-group spectrum, a semi-analytically described model spectrum and the user's experience. The IBM PC/AT program "BLOW UP" will be distributed by the IAEA NDS among the utility programs of the REAL-88 neutron spectrum adjustment reference file. (author). 9 refs, 3 figs.

**35317** (LA–12196) **MCNP: Photon benchmark problems.** Whalen, D.J.; Hollowell, D.E.; Hendricks, J.S. Los Alamos National Lab., NM (United States). Sep 1991. 94p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE92000694. Source: OSTI; NTIS; INIS; GPO Dep.

The recent widespread, markedly increased use of radiation transport codes has produced greater user and institutional demand for assurance that such codes give correct results. Responding to these pressing requirements for code validation, the general purpose Monte Carlo transport code MCNP has been tested on six different photon problem families. MCNP was used to simulate these six sets numerically. Results for each were compared to the set's analytical or experimental data. MCNP successfully predicted the analytical or experimental results of all six families within the statistical uncertainty inherent in the Monte Carlo method. From this we conclude that MCNP can accurately model a broad spectrum of photon transport problems. 8 refs., 30 figs., 5 tabs.

## 6550 Medical Physics

*Refer also to citation(s) 34128, 34130, 34928, 34992, 34993, 35127*

**35318** (CONF-910137–, pp. 1) **Federal radiation protection guidance.** Richardson, A. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Short communication. RADIATION PROTECTION/ recommendations; COMPLIANCE; IMPLEMENTATION; RECOMMENDATIONS; REGULATIONS; SAFETY STANDARDS

**35319** (CONF-910137–, pp. 17-23) **Features of DOE implementation of radiation protection guidance.** Jarrett, R.D. (Dept. of Energy, Washington DC (USA)); Foulke, J.D.; Jones, C.R. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

In 1988 the Department of Energy became the first Federal agency to adopt the Presidential Guidance prepared by the Environmental Protection Agency, which incorporated the recommendations of the International Commission on Radiological Protection published in 1977. The most important provisions adopted are discussed in this paper. Two controversial issues are also discussed. Problem areas which gave rise to proposed revisions are explained.

**35320** (CONF-910137–, pp. 24-31) **Rethinking basic concepts in ICRP's system of dose limitation.** Mills, W.A. (Oak Ridge Associated Universities, Washington DC (USA)); Mossman, K.L. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The present criterion for radiation protection appears to be exposure reduction rather than adequate protection of health. The 1990 ICRP draft recommendations for a system of dose limitation would further implement this more restrictive criterion by implementing certain academic concepts and assumptions. These concepts and assumptions are discussed and the suggestion is made that the radiation protection community needs to carefully examine the need for the complex system proposed.

**35321** (CONF-910137–, pp. 32) **NCRP and ICRP - What's happening?.** Meinhold, C.B. (Brookhaven National Lab., Upton, NY (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. DOE Contract AC02-76CH00016. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

As a result of the 1986 data from the Japanese life span study UNSCEAR (1989) and the NAS BEIR (1990) performed an in-depth analysis of all the current information on risks to man from ionizing radiation. Acting on the same preliminary information, NCRP made a number of suggestions reflecting the possible change in risk estimates in its NCRP 91 (1987). ICRP began a review of its Publication 26 (1977) and concluded that a revision would be needed. Both ICRP and NCRP set up task groups to provide evaluations of the available risk information as it might apply to radiation protection. Both risk committees have concluded their work and the results are quite similar. The ICRP's revisions to its basic recommendations are virtually complete and should be available shortly. Since the NCRP considered this data in its 1987 reports, substantial changes are not likely in its recommendations on limits.

**35322** (CONF-910137–, pp. 55-62) **Benefits of the effective dose equivalent concept at a medical center.** Vetter, R.J. (Mayo/Clinic Foundation, Rochester, MN (USA)); Classic, K.L. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

A primary objective of the recommendations of the International Committee on Radiological Protection Publication 26 is to insure that no source of radiation exposure is unjustified in relation to its

benefits. This objective is consistent with goals of the Radiation Safety Committee and Institutional Review Board at medical centers where research may involve radiation exposure of human subjects. The effective dose equivalent concept facilitates evaluation of risk by those who have little or no knowledge of quantities or biological effects of radiation. This paper presents effective dose equivalent data used by radiation workers and those who evaluate human research protocols as these data relate to personal dosimeter reading, entrance skin exposure, and target organ dose. The benefits of using effective dose equivalent to evaluate risk of medical radiation environments and research protocols are also described.

**35323** (CONF-910137–, pp. 81-94) **UK experience with ICRP26 and ICRP30.** Dray, C.H. (NE America, Monmouth Junction, NJ (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

ICRP26 was adopted in January 1977 which took into account information emerging since the adoption of ICRP9 in September 1969 and specified the basic criteria for dose limitation which still apply today. ICRP30 defines the limits for intakes for radionuclides for workers, and enables the health physicist and regulatory bodies to make appropriate limits for annual intake, air contamination etc, to comply requirements of dose-equivalent commitment and committed dose equivalent. The publication of ICRP26 is reflected in European Communities directive 80/836/Euratom. Council Directive of 15th July 1980 amending the Directive laying down the basic safety standards for the health protection of general public and workers against the dangers of ionizing radiations. This document being required the member states to bring the requirements of the directive within their legislation. In the United Kingdom this was accomplished by the publication of the Ionizing Radiations Regulations 1985.

**35324** (CONF-910137–, pp. 95-103) **Deficiencies in radiation protection record systems.** Martin, J.B. (Pacific Northwest Lab., Richland, WA (USA)); Lyon, M. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. DOE Contract AC06-76RL01830. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Radiation protection records are a fundamental part of any program for protecting radiation workers. Records are essential to epidemiological studies of radiation workers and are becoming increasingly important as the number of radiation exposure litigation cases increases. Ready retrievability of comprehensive records is also essential to the adequate defense of a radiation protection program. Appraisals of numerous radiation protection programs have revealed that few record-keeping systems comply with American National Standards Institute, Standard Practice N13.6-1972. Record-keeping requirements and types of deficiencies in radiation protection records systems are presented in this paper, followed by general recommendations for implementing a comprehensive radiation protection records system.

**35325** (CONF-910137–, pp. 2-16) **Overview of the revised 10 CFR Part 20, standards for protection against radiation.** Peterson, H.T. (Nuclear Regulatory Commission, Washington DC (USA)); Cool, D.A.; Buchanan, J.D.; Cool, W.S. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The revised 10 CFR Part 20 is based upon the 1977 recommendations of the International Commission of Radiological Protection and is generally consistent with the 1987 recommendations of the National Council on Radiation Protection and Measurements. The revised Part 20 contains significant changes from past practice and procedures for estimating, measuring, combining, recording and reporting doses. These changes are associated with the introduction of new concepts and methods of assessing doses.

**35326** (CONF-910137–, pp. 104-108) **NVLAP and DOELAP dosimetry accreditation programs.** Loesch, R.M. (Dept. of Energy, Washington, DC (USA)); Gladhill, R.L.; McDonald, J.C.; Carlson, R.D. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

There are two programs that are operated by US Government agencies for the accreditation of personnel dosimetry processors. They are the National Voluntary Laboratory Accreditation Program (NVLAP) and the Department of Energy Laboratory Accreditation Program (DOELAP). These two programs exhibit many similarities, but there are some notable differences. Both have been in operation for a number of years, and this paper will discuss their experiences to date and plans for their future development.

**35327** (CONF-910137–, pp. 110-113) **Teledosimetry in a spent fuel pool.** Desrosiers, A.E. (Bartlett Nuclear, Inc., Plymouth, MA (USA)); Moyles, M. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Recently, the USNRC reemphasized the regulations concerning the definition of whole body dose. Specifically, the dose to the ankle is included in whole body dose. When the radiation field gradient is very strong and the dose rates are very high, monitoring the dose to the ankle is a special challenge. In order to adequately protect drivers in a spent fuel pool, the authors develop a program that is a marked departure from the concepts of prejob surveys and staytimes. They decided to directly instrument five major points of the whole body and use telemetry and individual local alarms to control radiation dose. In this paper they explain this concept and extrapolate to similar situations.

**35328** (CONF-910137–, pp. 119-126) **Is the ICRP-26 weighting factor for gonadal dose appropriate for new federal regulations?.** Drum, D.E. (Brigham and Women's Hospital and Harvard Medical School, Boston, MA (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

In 1977 the ICRP recommended that computation of the occupational whole body effective dose equivalent include individual organ dose weighting factors derived from risk coefficients for stochastic effects. The-preeminent weighting factor of 0.25 was assigned to irradiation of the gonads in order to account for heritable genetic effects manifest in later generations. As of 1990, there exists no positive significant evidence for the occurrence of transmitted genetic effects in humans after radiation of any form, dose, or dose rate. To assign to gonads 25% of the health detriment from radiation has no basis in medical experience. It establishes a policy that may underestimate the proportion of real mortality from other more radiosensitive organs, and the policy could compromise unreasonably the occupational stability of workers whose activities may involve gonadal irradiation.

**35329** (CONF-910137–, pp. 164) **ALARA for the practical person.** Kathren, R.L. (Hanford Environmental Health Foundation, Richland, WA (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The increasing significance of ALARA in recent years has spawned numerous articles and complex technological means to achieve as low as reasonably achievable. The available body of literature on ALARA has grown so large and complex that it is an overwhelming and virtually impossible task for a single individual to remain abreast of it. Regulatory requirements and interpretations of ALARA further add to the difficulties of the operational radiation protection staff seeking ALARA. The practical person can, however, promote and provide ALARA by recalling and applying certain simple principles, including the following, which will be discussed in depth: (1) ALARA is basic and fundamental to any program of radiological protection, and as such the ALARA program or practices must be specifically identifiable. (2) ALARA is a never ending quest, and much like the speed of light or halving the distance to the goal, can really never be reached in a theoretical sense. (3) ALARA is not necessarily synonymous with dose reduction, and certainly does not involve ever continuous reduction in dose. (4) There is no single monetary value applicable to a unit of dose; rather each incremental unit of dose must be examined in the total context of the exposure situation. (5) ALARA involves professional opinion and judgment; responsible and qualified professional health physicists may differ in their opinions as to what constitutes ALARA.

**35330** (CONF-910137–, pp. 196-203) **New influences on the ALARA concept.** Alexander, R.E. (The Alexander Corp., Fairfax, VA (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The ALARA concept is an essential component of an occupational radiation protection program because the fatality risk associated with continued exposure at or near the 5-rems/year limit is unacceptably high. Using a risk coefficient of $4 \times 10^{-4}$ fatalities/person-rem the risk for a large worker population exposed in this manner for a working lifetime would be 10%. The ICRP fatality risk criterion is an average of 1 per year per 10 thousand workers. The average annual dose that would achieve this objective depends on the risk coefficient used. Using $4 \times 10^{-4}$ again, the annual dose average would have to be 0.25 rem, a factor of 20 below the limit. It is evident that the ALARA concept is the most important aspect of occupational radiation protection and that the justification for an effective ALARA program is the cancer fatality risk. Not quite so evident but nonetheless important is the consideration that once the ICRP criterion is achieved, it is probably int eh best interest of the workforce to use resources available for their health and safety to reduce other risks. In this paper the risk information under examination by the government agencies is reviewed from the viewpoint of dose reduction through enhanced implementation of the occupational ALARA concept.

**35331** (CONF-910137–, pp. 214-215) **The legal aspects of fetal protection policies in the workplace.** Jose, D.E. (Pepper, Hamilton, and Scheetz, Philadelphia, PA (USA)); Scott, E.K. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The concerns of working women have received increasing attention from lawmakers, employers and women themselves as more and more American women enter the workforce. Fetal protection policies evidence a growing awareness by employers that their workplace poses special hazards to the unborn children of women workers. Yet, the fetal protection area is fraught with tension between legitimate competing concerns. Women expect equal employment opportunities, and employers are legally bound to provide equal treatment; however, these interests are challenged by women's desire to deliver healthy babies and employers' desire to avoid causing fetal defects or to be sued for naturally occurring genetic defects. Title 7 of the Civil Rights Act of 1964 and various state laws on fair employment practice embodies societal concerns for fairness in employment as it relates to fetal protection. Fetal protection policies are one example in which discriminatory practices are implicated since under such policies employers may refuse to hire or segregate previously hired pregnant women or women of child bearing age on the grounds that such exclusion or segregation is necessary to protect fetal health or the reproductive capacity of the female employee. A dilemma is presented to the employer of any nuclear workforce which includes women since the permissible dose for a man or woman is many times larger than the dose for a fetus.

**35332** (CONF-910137–, pp. 216) **Mathematical phantoms and specific absorbed fractions for the adult female at three, six, and nine months of pregnancy.** Watson, E. (Oak Ridge Associated Univ., TN (USA)); Stabin, M.; Eckerman, K.; Cristy, M.; Ryman, J.; Davis, J.; Marshall, D. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Estimation of radiation dose requires information on the absorbed fractions of energy for organs and tissues of the body. The Snyder-Fisher phantom, developed at Oak Ridge National Laboratory (ORNL) to represent a 70 kg adult, has been widely used to compute absorbed fractions. A series of phantoms, also developed at ORNL, represent individuals of various ages from newborns to adults, and are used in estimation of tissue dose for radiation workers, members of the general public, and nuclear medicine patients. Because of its size (56 kg), the 15-year-old phantom from this series has also been used to represent the average adult female. We have adapted this model for the adult female and have incorporated anatomical changes which occur during pregnancy. The size and composition of the fetus as a function of gestational age, the position and shape of the various abdominal organs, and the nature of magnitude of other changes which occur in the body during pregnancy (e.g. the spreading of the pelvic bones) were determined from the literature. Models for three, six, and nine months gestation were developed by incorporating the appropriate changes into the adult female phantom. The model was implemented in the ALGAMP Monte Carlo codes at ORNL to calculate the absorption of radiation within the phantom from internal sources of radiation. The results of these calculations will be presented, along with a description of the models and assumptions used in the simulations.

**35333** (CONF-910137–, pp. 217) **The informed radiation worker and fetal dose policies.** Harshaw, F.B. (Columbia Univ., New York, NY (USA)). Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

The role of women in a workplace in which radioactive materials and radiation producing equipment are used has never been more controversial than it is now. So important, in fact, has this become that the Supreme Court has decided to hear a case that will have major implication not only for female radiation worker but for all employers and certainly for all health physicist involved in attempting to set a reasonable policy for the female worker and her potential for pregnancy. In this paper, a review of the recent BEIR V information and the UNSCEAR data will be made as well as a review of fetal development. Also, the ALARA requirements will be reviewed. Finally, risk perception will be discussed.

**35334** (CONF-910137–, pp. 242-247) **University/Hospital fetal dose policy experiences.** Wilson, B.M. (Univ. of North Carolina, Chapel Hill (USA)); Vinson, W.R.; Deforest, W.W.; Washburn, D.B. Health Physics Society, NC (United States). North Carolina Chapter. [1991]. From 24. midyear topical meeting of the Health Physics Society; Raleigh, NC (United States); 20-25 Jan 1991. In *Implementation of current NCRP and ICRP guidance and revised 10 CFR Part 20: Proceedings.* 257p. Order Number DE91016184. Source: OSTI; NTIS; INIS.

Since at least 1981, an informal policy has existed at the authors research university and teaching hospital institution to interview, inform and assure appropriate personnel monitoring for pregnant radiation workers. Events, such as popular and technical publications (NCRP 87) and the maturation of NRC's proposed changes in 10 CFR 20 (NRC 88), brought increased attention to the subject of fetal radiation dose. The need for a formal approach to the subject became evident. By 1987, a concerted effort to promulgate a formal policy was launched. A draft policy statement was presented to each institutional radiation safety committee for review and action. There was immediate strong interest. A thorough, multilevel review, comment and redraft process developed. Well tested policy statements were then approved in 1988.

**35335** (INIS-mf–12958, pp. 18-34) **Dosimetry quality assurance in the U.S. from the experience of the Radiological Physics Center.** Hanson, W.F. (Texas Univ., Houston, TX (USA). M.D. Anderson Cancer Center); Shalek, R.J.; Kennedy, P. International Atomic Energy Agency, Vienna (Austria). Div. of Life Sciences; World Health Organization, Geneva (Switzerland). Apr 1991. 59p. In *SSDL Newsletter. No. 30.* Order Number DE92601235. Source: OSTI; NTIS (US Sales Only); INIS.

Hard copies are available from IAEA Division of Life Sciences, Dosimetry Section.

For more than two decades, the Radiological Physics Center (RPC), has monitored radiation therapy dosimetry at those institutions participating in cooperative clinical trails funded by the U.S. National Cancer Institute (and recently by the National Eye Institute). There has been a significant improvement in external beam calibration over that time. A mailed TLD program has been implemented that monitors machine calibration for photon and electron beams, and energy of electron beams. This is an effective screening mechanism for identifying potential problems at the participating institutions. Review of patient treatment records by the RPC is shown to improve the accuracy of dosimetry in radiotherapy, and thus has a significant benefit to the reliability of radiation data for clinical trials. 23 refs, 6 figs, 11 tabs.

**35336** (INIS-mf–12958, pp. 35-54) **New practice for the calibration of radiotherapy dosimeters.** Jaervinen, H. (SSDL, Helsinki (Finland)). International Atomic Energy Agency, Vienna (Austria). Div. of Life Sciences; World Health Organization, Geneva (Switzerland). Apr 1991. 59p. In *SSDL Newsletter. No. 30.* Order Number DE92601235. Source: OSTI; NTIS (US Sales Only); INIS.

Hard copies are available from IAEA Division of Life Sciences, Dosimetry Section.

As a result of the new international recommendation for radiotherapy dosimetry, the standard dosimetry laboratory has applied of the Finnish Centre for Radiation and Nuclear Safety has applied the following practice for the calibration of radiotherapy dosimeters from January 1, 1989: (i) The calibration is carried out with a $^{60}Co$ gamma radiation beam; (ii) To calculated the calibration factor N for cylindrical chambers, the values of the necessary parameters are taken from the recommendation by the IAEA. Two new parameters are used, correction factors $P_{cel}$ and $P_{eff}$; (iii) To calculated the calibration factor N for parallel plate chambers (only for electron radiation), the values of stopping-power ratio $(s_{w,air})_u$, perturbation correction factor $P_u$ and the correction factor for parallel plate chamber $k_{pp}$ are still taken from the recommendation by the Nordic Association of Clinical Physics. The values of all parameters used for the calculation of calibration factor N are given as an Appendix. 3 refs.

**35337** (INIS-mf–12958, pp. 55-57) **Absorbed dose intercomparison studies for Co-60 therapy units by the SSDL, Istanbul, Turkey.** Yasar, S. (Cekmece Nuclear Research and Training Centre, Istanbul (Turkey). Dosimetry Lab.); Kiyak, N.; Turer, A.; Alkan, H. International Atomic Energy Agency, Vienna (Austria). Div. of Life Sciences; World Health Organization, Geneva (Switzerland). Apr 1991. 59p. In *SSDL Newsletter. No. 30.* Order Number DE92601235. Source: OSTI; NTIS (US Sales Only); INIS.

Hard copies are available from IAEA Division of Life Sciences, Dosimetry Section.

In 1989, CNAEM Secondary Standard Dosimetry Laboratory (SSDL) undertook a TLD intercomparison programme using the IAEA/WHO method for the user of Co-60 teletherapy units to raise the dosimetric accuracy in radiotherapy. For this purpose, the radiotherapy centres in Turkey are sent plastic capsules containing LiF by post and are asked to irradiate these capsules to an absorbed dose of 2.0 Gy at a depth of 5 cm in water. The irradiated TLD capsules are returned to the SSDL by the radiotherapy centres. The given dose to the capsule is determined by SSDL and this measured dose is compared with stated dose by the radiotherapy centre. In this intercomparison were found that the 9 radiotherapy centres have less than +-5% deviation and 3 radiotherapy centres have higher than +-5% deviation. 6 refs, 1 tab.

**35338** (KURRI-TR–347) **Proceedings of the conference on health physics: Future development of health physics.** Tsujimoto, Tadashi; Mizuma, Mitsuo (eds.). Kyoto Univ., Kumatori, Osaka (Japan). Research Reactor Inst. Mar 1991. 35p. (In Japanese). (CONF-9003295–: Conference on health physics, Kumatori (Japan), 20 Mar 1990). Order Number DE92704335. Source: OSTI; NTIS (US Sales Only); INIS.

This booklet presents nine talks given at the Conference on Health Physics, which was held on March 20, 1990, at Research Reactor Institute of Kyoto University (KURRI), Japan. The first talk discusses future trends in health physics, focusing on the application of computers, development of new techniques, energy industries, and administrative regulations. The second talk discusses the importance of health physics in relation to nuclear energy. The third one addresses importance of health physics in relation to medical treatment. The fourth and fifth ones discuss the present status and future trends in education in health physics. The sixth one focuses on education in health physics, placing emphasis on grass-roots activities in this field. The seventh and eighth talks discusses various activities to be carried out in the future by the Health Physics Research Center. The ninth one describes major developments leading to the establishment of the Health Physics Research Center. Three appendices are attached which respectively summarizes major subjects at a meeting on the budget for the Health Physics Research Center, outlines some studies for radiation control in space aircraft and space bases, and describes major reasons for the necessity of the Health Physics Research Center. (N.K.).

**35339** (NIRS-M–78, pp. 247-255) **Revision of the ICRP dosimetric model for the human respiratory tract.** Bair, W.J. (Pacific Northwest Lab., Richland, WA (USA)). National Inst. of Radiological Sciences, Chiba (Japan). Mar 1991. (CONF-891290–: 21. annual NIRS symposium on inhalation of airborne particles and induction mechanisms, Chiba (Japan), 7-9 Dec 1989). In *Inhalation of airborne particles and mechanisms for induction of biological effects.* 271p. Order Number DE91508518. Source: OSTI; NTIS (US Sales Only); INIS.

Although the dosimetric model of the respiratory tract used in ICRP Publication 30 had not been shown to be seriously deficient for the purpose of calculating Annual Limits on Intake (ALIs) for workers, the availability of new information led the ICRP in 1984 to create a special Task Group to review the dosimetric model of the respiratory tract and, if justified, propose revisions or a new model. The Task Group directed its efforts towards improving the model used in Publication 30 rather than developing a new model. The objective was a model that would: Facilitate calculation of biologically meaningful doses; be consistent with morphological, physiological, and radiobiological characteristics of the respiratory tract; incorporate current knowledge; meet all radiation protection needs; be user friendly by not being unnecessarily sophisticated; be adaptable to development of computer software for calculation of relevant radiation doses from knowledge of a few readily measured exposure parameters; be equally useful for assessment purposes as for calculating ALIs; be applicable to all members of the world population; and consider the influence of smoking, air pollutants, and diseases of the inhalation, deposition, and clearance of radioactive particles from the respiratory tract. Rather than calculating an average dose to the total lungs, emphasis was given to calculating doses to tissues and cells of most concern, those that had shown evidence of susceptibility to radiation induced cancers either in humans or in experimental animals. Since both the radiation dose and the cancer susceptibility of each region determine the overall risk to the respiratory tract of a given radionuclide

intake, the model provides for calculation of a committed dose equivalent for each region, adjusted for the relative cancer sensitivity of that region, and for the summing of these to yield a committed dose equivalent for the entire respiratory tract. J.P.N.

## 6560 Condensed Matter Physics

*Refer also to citation(s) 33592, 33598, 34450, 34507, 34548, 34902, 34960, 35171, 35178, 35433, 35435*

**35340** (GSI–91-30(prepr.)) **$\beta$, $Z_{eff}$, dE/dx, range and restricted energy loss of heavy ions in the region $1 \leq E \leq 1000$ MeV/nucleon.** Heinrich, W. (Siegen Univ. (Gesamthochschule) (Germany, F.R.). Fachbereich 7 - Physik); Wiegel, B.; Kraft, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany). Jun 1991. 25p. Order Number DE92714426. Source: OSTI; NTIS (US Sales Only); INIS.

The scope of this report is to support the biophysics users of SIS heavy ion beams with data of energy loss (dE/dx), range and restricted energy loss. (orig.).

**35341** (IAEA-TECDOC–572, pp. 93-102) **Evaluation of radiation effects in amorphous (-solid) matter.** Matthes, W. (Commission of the European Communities, Ispra (Italy). Joint Research Centre). International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

A theoretical model of evaluation of radiation effects in solid matter is presented. At low radiation exposures changes in the atomic densities of the atoms in the media can be neglected and the equations become linear and are solved analytically. As an example damage production rates in $^{56}Fe$ were calculated in the energy range 7.0 to 40 MeV. (author). 5 refs, 4 figs, 1 tab.

**35342** (INIS-SU–266) **5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.** AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers are indexed.

**35343** (INIS-SU–266, pp. 176) **Effect of positron irradiation on lifetime of alkali halogen crystal in electric field.** Chormonov, A.B. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Khimii Vysokikh Ehnergij; AN SSSR, Moscow (USSR). Inst. Fizicheskoj Khimii; Kemerovskij Gosudarstvennyj Univ., Kemerovo (USSR). 1990. 189p. (In Russian). (CONF-9005373–: 5. all-union conference on radiation heterogeneous processes, Kemerovo (USSR), 28-31 May 1990). In *5. All-union conference on radiation heterogeneous processes. Part 2: Summaries of reports.* Order Number DE92001306. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. POTASSIUM CHLORIDES/color centers; POTASSIUM CHLORIDES/physical radiation effects; ELECTRIC FIELDS; HIGH TEMPERATURE; LIFETIME; POSITRON BEAMS; STRONTIUM ADDITIONS

**35344** (INIS-SU–276, pp. 22) **Subnanosecond scintillators based on alkali metal and alkali earth metal fluorides.** Valbis, Ya.A. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. PHOSPHORS/barium fluorides; PHOSPHORS/lutetium fluorides; PHOSPHORS/yttrium fluorides; CALCIUM FLUORIDES; CESIUM FLUORIDES; MERCURY FLUORIDES; MONOCRYSTALS; PHOSPHORS; POTASSIUM FLUORIDES; QUANTITY RATIO; ULTRAVIOLET RADIATION

**35345** (INIS-SU–276, pp. 32) **Cross-luminescence in alkali metal fluorides under pulsed synchrotron radiation excitation.** Aleksandrov, Yu.M.; Makhov, V.N.; Khajdukov, N.M.; Yakimenko, M.N. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CESIUM FLUORIDES/photoluminescence; LUTETIUM FLUORIDES/photoluminescence; MAGNESIUM FLUORIDES/photoluminescence; POTASSIUM FLUORIDES/photoluminescence; RUBIDIUM FLUORIDES/photoluminescence; YTTRIUM FLUORIDES/photoluminescence; PHOTOLUMINESCENCE; EV RANGE 10-100; LOW TEMPERATURE; MEDIUM TEMPERATURE; MONOCRYSTALS; SYNCHROTRON RADIATION; TEMPERATURE DEPENDENCE; ULTRAVIOLET RADIATION

**35346** (INIS-SU–276, pp. 81) **Compound fluoride cross-luminescence.** Valbis, Ya.A.; Rachko, Z.A.; Khajdukov, N.M.; Yansons, Ya.L. AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii. 1990. 192p. (In Russian). (CONF-9007215–: 9. all-union conference on chemistry of inorganic fluorides, Cherepovets (USSR), 3-6 Jul 1990). In *9. All-union conference on chemistry of inorganic fluorides. Pt. 1: Summaries of reports.* Order Number DE92001312. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. LUTETIUM FLUORIDES/luminescence; POTASSIUM FLUORIDES/luminescence; RUBIDIUM FLUORIDES/luminescence; YTTRIUM FLUORIDES/luminescence; ELECTRON BEAMS; KEV RANGE 01-10; LUMINESCENCE; MONOCRYSTALS; TIME DEPENDENCE; ULTRAVIOLET RADIATION

**35347** (JINR-D–4-89-221, pp. 66-73) **Collective effects during nuclear gamma resonance.** Yukalov, V.I. (Joint Inst. for Nuclear Research, Dubna (USSR)). Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

A possibility of new collective effects for the system of Moessbauer nuclei in the external constant field, which is electric one for nuclear E1-transitions and magnetic for M1 ones is shown. Nucleus interaction by means of gamma-quantum exchange in the presence of such an external field, supplementing the variable resonance field, leads to the occurrence of coherent state in which transition dipoles are arranged along the external constant field. As a result of this coherent radiation occurs, internal conversion coefficient is reduced, and the Moessbauer absorption cross section and area under the resonance spectrum are increased. 10 refs.

**35348** (KEK-PR–90-2) **KENS report-8, 1989/90.** Ikeda, H.; Furusaka, M.; Watanabe, N. (eds.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). 1991. 292p. Order Number DE92704329. Source: OSTI; NTIS (US Sales Only); INIS.

In this report, the research progress at the KENS facility during the period from April, 1988 to September, 1990 is summarized. In this period, proton beam intensity was gradually increased, and in March, 1989, the proton beam intensity of $2 \times 10^{12}$ protons per pulse corresponding to 6.7 $\mu$A in time-averaged beam current at 20 Hz was successfully achieved with the 500 MeV booster synchrotron.

During this period, efforts were exerted to maintain research activities with very modest proton beam intensity in KENS. A program to improve the performance of all instruments by about ten times in intensity equivalence (data rate, resolution, signal to background ratio and so on). In some instruments, the improvement has already been achieved, while in the remainder, it is still in progress. At the same time, a program to build up and promote better science was started. About ten workshops a year of small size are organized on various fields of research using pulsed neutrons. The progress in KENS, the summary of booster synchrotron operation, the instruments in KENS, the scientific reports on neutron scattering, instrumentations and the development for future program and Japan-UK collaboration on neutron scattering are reported. (K.I.).

**35349** (LA-UR-91-2951) **Derivation of the high field semiconductor equations.** Hagan, P.S. (Los Alamos National Lab., NM (United States)); Cox, R.W.; Wagner, B.A. Los Alamos National Lab., NM (United States). [1991]. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9107176--1: 1991 IMA semiconductor workshop, Minneapolis, MN (United States), 15 Jul - 9 aug 1991). Order Number DE92000249. Source: OSTI; NTIS; GPO Dep.

Electron and hole densities evolve in x-z phase space according to Boltzmann equations. When the mean free path of the particles is short and electric force on the particles is weak, a well-known expansion can be used to solve the Boltzmann equation. This asymptotic solution shows that the spatial density of electrons and holes evolves according to diffusion-drift equations. As devices become smaller, electric fields become stronger, which renders the Basic Semiconductor Equations increasingly inaccurate. To remedy this problem, we use singular perturbation techniques to obtain a new asymptotic expansion for the Boltzmann equation. Like the Hilbert expansion, the new expansion requires the mean free path to be short compared to all macroscopic length scales. However, it does not require the electric forces to be weak. The new expansion shows that spatial densities obey diffusion-drift equations as before, but the diffusivity D and mobility $\mu$ turn out to be nonlinear functions of the electric field. In particular, our analysis determines the field-dependent mobilities $\mu(E)$ and diffusivities D(E) directly from the scattering operator. By carrying out this asymptotic expansion to higher order, we obtain the high frequency corrections to the drift velocity and diffusivity, and also the corrections due to gradients in the electric field. Remarkably, we find that Einsteins's relation is still satisfied, even with these corrections. The new diffusion-drift equations, together with Poissons' equation for the electric field, form the high-field semiconductor equations, which can be expected to be accurate regardless of the strength of the electric fields within the semiconductor. In addition, our analysis determines the entire momentum distribution of the particles, so we derive a very accurate first moment model for semi-conductors by substituting the asymptotically-correct distribution back into the Boltzmann equation and taking moments.

**35350** (LA-UR-91-2968) **Neutron Brillouin scattering in a metallic glass.** Suck, J.B. (Kernforschungszentrum Karlsruhe GmbH (Germany). Inst. fuer Nukleare Festkoerperphysik); Egelstaff, P.A.; Robinson, R.A.; Sivia, D.S.; Taylor, A.D. Los Alamos National Lab., NM (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109103--1: 5. international conference on the structure of non-crystalline materials, Sendai (Japan), 2-6 Sep 1991). Order Number DE92000219. Source: OSTI; NTIS; GPO Dep.

The dispersion of collective modes in a metallic glass ($Mg_{70}Zn_{30}$) measured earlier at the thermal neutron time-of-flight spectrometer IN4 of the HFR of the ILL could be extended towards lower momentum transfers down to the first pseudo-Brillouin zone for the first time. This extension to momentum transfer not accessible up to now was possible using the highly resolving time-of-flight spectrometer HET of the new spallation source ISIS. In the region of overlap the two parts of the dispersion determined with different samples of the same metallic glass on different instruments agree very well. Also the earlier discrepancies with the dispersion determined for this metallic glass from a computer simulation could be nearly completely eliminated due to a more recent and more complete investigations of this glass.

**35351** (LA-UR-91-3135) **Lagrangian analysis, data covariance, and the impulse time integral.** Forest, C.A. Los Alamos National Lab., NM (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9107105--52: 1991 American Physical Society (APS) conference on shock compression of condensed matter, Williamsburg, VA (United States), 17-20 Jul 1991). Order Number DE92000169. Source: OSTI; NTIS; GPO Dep.

Lagrangian analysis is mathematical analysis of data derived from flow experiments in which embedded gauges move with the material motion (constant Lagrangian mass-point coordinate). With sufficient data, the conservation laws of mass, momentum, and energy are applied to the data in order to construct flow-variable fields, of particle velocity, stress, density, et cetera. Toward this end, a new Lagrangian analysis method has been constructed, that is centered upon a function, $\alpha$, that incorporates conservation of mass and momentum into its definition. Further, the existence of $\alpha$ allows simultaneous, consistent, least-squares fitting of surfaces to all of the flow data. The method also incorporates a novel treatment of the data covariance effects resulting from gauge-to-gauge calibration uncertainty. Analysis of a synthetic data set illustrates the method. 8 refs., 8 figs.

**35352** (NIFS-85) **Dependence of $Au^-$ production upon the target work function in a plasma-sputter-type negative ion source.** Okabe, Yushirou; Sasao, Mamiko; Fujita, Junji; Yamaoka, Hitoshi; Wada, Motoi. National Inst. for Fusion Science, Nagoya (Japan). May 1991. 32p. Order Number DE92713936. Source: OSTI; NTIS (US Sales Only); INIS.

A method to measure the work function of the target surface in a plasma-sputter-type negative ion source has been developed. The present method can be used to determine the work function by measuring the photoelectric current induced by two lasers (He-Ne, $Ar^+$ laser). The dependence of $Au^-$ production upon the work function of the target surface in the ion source was studied using this method. The time variation of the target work function and $Au^-$ production rate were measured during the cesium coverage decrease due to the plasma ion sputtering. The observed minimum work function of a cesiated gold surface in an Ar plasma was 1.3 eV where the negative ion production rate ($Au^-$ current/target current) took the maximum value. The negative ion production rate showed the same dependence on the incident ion energy as that of the sputtering rate when the work function was constant. (author).

**35353** (NIFS-88) **High resolution spectroscopy of $H^+$ energy loss in thin carbon film.** Matsunami, Noriaki (Nagoya Univ. (Japan). Faculty of Engineering); Kitoh, Kenshin. National Inst. for Fusion Science, Nagoya (Japan). May 1991. 22p. Order Number DE92713939. Source: OSTI; NTIS (US Sales Only); INIS.

The energy loss of $\approx$100 keV $H^+$ transmitted through thin carbon film of $\approx$7 nm has been measured with the resolution of $\approx$20 eV. We have observed new energy loss peaks around 210 and 400 eV in addition to the normal energy loss peak around 1 keV. We find that the experimental artifacts, ionization of C K-(290 eV) and impurity inner-shells, extreme non-uniformity of films, events associated with elastic scattering are not responsible for these peaks. The origin of these low energy loss peaks will be discussed. (author).

**35354** (NIFS-PROC-5, pp. 35-44) **Study on ablation of target material induced by pulsed ion beam bombardment.** Kamihata, S. (Kobe Univ. of Mercantile Marine (Japan)); Kitamura, A.; Furuyama, Y.; Nakajima, T. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185--: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications.* 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

Process of ablation due to irradiation of medium power pulsed ion beams (PIB) with a power level of $10^7$-$10^8$ W/cm$^2$, which have been proved useful for material processing, is investigated with use of a charge collector method and a 'collector-RBS method'. In the letter, the ablation particles are collected onto a silicon probe surface, which is later subjected to Rutherford Backscattering Spectroscopy (RBS). Preliminary results of measurements on the ablation mass as a function of the ion current density and the

target material and on the ion energy include some interesting features, which must be followed by further investigation. (author).

**35355** (SAND–91-1861C) **Charge states of donor-hydrogen pairs in Si: A fragile balance.** Estreicher, S.K. (Texas Tech Univ., Lubbock, TX (United States). Dept. of Physics); Seager, C.H.; Anderson, R.A. Sandia National Labs., Albuquerque, NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9107146–3: 16. international conference on defects in semiconductors, Bethlehem, PA (United States), 22-26 Jul 1991). Order Number DE91018794. Source: OSTI; NTIS; GPO Dep.

The debonding rates of H-passivated P and As in silicon have been observed to be very sensitive to the concentration of majority and minority charge carriers. A theoretical study of the stable and metastable configurations of the {P,H} and {As,H} pairs in the 0 and +1 charge states has been carried out at the near-ab-initio Hartree-Fock level. These calculations show that the lowest-energy configuration in the 0 charge state is the highest-energy configuration in the +1 charge state and vice-versa. This bistability of donor-hydrogen pairs implies that H cannot remain in place upon change of charge state, whether $0 \rightarrow +1$ or $+1 \rightarrow 0$. Quantitative differences between the P and the As cases are qualitatively consistent with the observed differences in the temperature dependence of the debonding rates of {P,H} and {As,H}. 14 refs., 1 fig.

**35356** (UCRL-JC–106887) **Stray light implications of scratch/dig specifications.** Lewis, I.T. (Lawrence Livermore National Lab., CA (United States)); Ledebuhr, A.G.; Bernt, M.L. Lawrence Livermore National Lab., CA (United States). 22 Jul 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-9107115–47: Society of Photo-Optical Instrumentation Engineers (SPIE) meeting, San Diego, CA (United States), 21-26 Jul 1991). Order Number DE91018461. Source: OSTI; NTIS; GPO Dep.

The bidirectional transmittance distribution function (BTDF) of two sets of scratch/dig standard sets were measured. These sets were representative of the inspection standards used in the optical industry to characterize polished surface defects. Measurements were taken with a small (1 mm diameter) illumination beam to maximize signal. The increase in average BTDF that results from a single scratch or dig over the MIL-STD 20 mm diameter surface was then calculated to determine what overall impact a defect will have on system stray light above base surface scattering due to surface micro-roughness. A BTDF measurement was taken with the illumination beam centered on the defect, then with it centered on a smooth section of the reference sample to find the increase in scattering caused by the defect. Results show that dig scattering, when normalized to account for the single dig per 20 mm MIL-STD inspection area criteria, did not catastrophically increase the 0.05 $B_0$ ($B_0$ is the BTDF at 0.57°) at 633 nm characteristic of a high quality optical surface. As intuitively expected, dig scattering was angularly symmetric. Scratches, however, scattered highly directionally. Normalized BTDF is substantially increased from a smooth surface's typical 0.05 $B_0$ perpendicular to the scratch axis, but is unaffected in other angles. On average, the scratches may not have increased net surface scattering. Scattering from the defects on the surfaces below the 40-20 scratch/dig level was found to not cause a catastrophic increase in scattering over the level os a well-polished optic (typically 4Å rms roughness). Since comparisons with scratch/dig samples only serve to provide a measure of the localized defects, and fail to be useful in determining the low-level scattering from the surface microroughness, one should not assume that a "40-20" surface is necessarily a low-scattering optic. 6 figs., 4 tabs.

**35357** (UCRL-JC–106988) **Positron lifetimes in solids from first principles calculations.** Sterne, P.A. (Lawrence Livermore National Lab., CA (United States)); O'Brien, J.C.; Howell, R.H.; Kaiser, J.H. Lawrence Livermore National Lab., CA (United States). 7 Aug 1991. 10p. Sponsored by Welch (Robert A.) Foundation, Houston, TX (United States). DOE Contract W-7405-ENG-48. Grant Y-1135. (CONF-9108150–2: 9. international conference on positron annihilation, Szombathely (Hungary), 26-31 Aug 1991). Order Number DE92000088. Source: OSTI; NTIS; INIS; GPO Dep.

We present a first principles method for calculating positron lifetimes in solids, based on self-consistent calculations using the Linear Muffin-Tin Orbital method. Local density approximations are used for both electron-electron and electron-positron interactions. Results are presented for a variety of elemental metals and vacancies to demonstrate the reliability of this approach. Theoretical calculations of positron lifetimes can be used to interpret experimental data. As an examples of this, we interpret our experimental lifetime data for the oxide superconductor $Ba_{1-x}K_xBiO_3$ using calculations based on this method. 12 refs., 3 figs.

## 6561 Superconductivity

*Refer also to citation(s) 34523, 34524, 34526, 34527, 34528, 34539, 34540, 34541, 35357*

**35358** (ANL/CP–74020) **Vortex-lattice states of a two-dimensional electron system at strong magnetic fields.** Akera, H. (Indiana Univ., Bloomington, IN (United States). Dept. of Physics); MacDonald, A.H.; Norman, M.R. Argonne National Lab., IL (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38 ;FG02-86ER45247. (CONF-9107170–1: CAP-NSERC workshop on theoretical physics, Ontario (Canada), 28 Jul - 3 aug 1991). Order Number DE91018551. Source: OSTI; NTIS; INIS; GPO Dep.

To explore a possible superconducting phase, the microscopic mean- field equations are solved for the case of a two-dimensional electron system in the strong magnetic field limit where the Landau level quantization invalidates the semiclassical approximations in the Ginzburg-Landau (GL) theory. For delta-function attractive interactions there exist n + 1 pairing channels in the n – th Landau level. For $n \geq 1$ the order parameter differs markedly from expectations based on the GL theory and the excitation spectrum has a zero gap.

**35359** (CONF-8906112–, pp. 108-113) **Superconducting hysteresis and the Preisach model.** Mayergoyz, I.D. (Univ. of Maryland, College Park (USA)); Keim, T.A. Argonne National Lab., IL (United States). [1989]. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

It is suggested to use the Preisach hysteresis model for the description of superconducting hysteresis. It is shown that the Bean (critical) state model and its further generalizations are very particular cases of the Preisach model. It is also shown that noncyclic hysteresis losses in superconductors can be evaluated by using the Preisach model and experimentally measured first-order transition curves. In the area of magnetics, the Preisach model has long been used for the description of hysteresis of ferromagnetic materials. Recently, the phenomenological nature of the Preisach model has been revealed, and it has been emphasized that under certain conditions this model can be used for the description of hsteresis of any physical nature. It has also been shown that, by using the Preisach model, noncyclic hysteresis losses can be easily evaluated. In this paper, it is suggested to use the Preisach model for the description of superconducting hysteresis. It is shown that the critical state model and its generalizations are very particular cases of the Preisach model. It is proposed to evaluate hysteresis losses in superconductors by using the Preisach model and experimentally measured first-order transition curves.

**35360** (NEI-DK–634) **High-Tc superconductivity: Summary report.** Hedegaard, P. (HCOe-Physics Laboratory (DK)); Engell, J.; Jacobsen, C.S.; Nielsen, M.; Gutzon Larsen, J.; Freltoft, T. Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Danmarks Tekniske Hoejskole, Copenhagen (Denmark); Risoe National Lab., Roskilde (Denmark). Physics Dept.; Aarhus Univ. (Denmark); Haldor Topsoee, Vedbaek (Denmark); NKT A/S, Broendby (Denmark). Aug 1990 39p. Order Number DE92703878. Source: OSTI; NTIS (US Sales Only).

The present summary report is intended to serve as a basis for the work of an evaluation panel, appointed by The Danish Natural Science Research Council, The Danish Technical Research Council, and the Danish Board of Technology in order to assess the

ongoing Danish research programme in the field of high temperature superconductivity. The report gives a brief description of the research as organized in topics. A complete list of publications, reports, patents and theses originating from the work is given. (author) 79 refs.

**35361** (NEI-DK–635) **High-Tc superconductivity: Laboratory report.** Copenhagen Univ. (Denmark). H.C. Oersted Inst.; Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark); Danmarks Tekniske Hoejskole, Copenhagen (Denmark); Risoe National Lab., Roskilde (Denmark). Physics Dept.; Aarhus Univ. (Denmark); Haldor Topsoee, Vedbaek (Denmark); NKT A/S, Broendby (Denmark). Aug 1990 118p. Order Number DE92703879. Source: OSTI; NTIS (US Sales Only).

Descriptions of the methods used and results achieved in relation to coordinated research experiments on High-$T_c$ superconductivity carried out at the physics department at Risoe National Laboratory and other research institutions in Denmark. Bibliographical references to papers published by the researchers, and conference contributions, are included. (AB).

## 6570 Theoretical and Mathematical Physics

*Refer also to citation(s) 34216, 34803, 34848, 35438*

**35362** (DESY–91-038) **Two-dimensional gravities and supergravities as integrable systems.** Nicolai, H. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany). May 1991. 46p. (CONF-9103180–: 30. Schladming winter school on nuclear physics: Recent aspects of quantum fields, Schladming (Austria), 27 Feb - 8 mar 1991). Order Number DE92714442. Source: OSTI; NTIS (US Sales Only); INIS.

After a general introduction to the hidden symmetries of Einstein's theory of relativity in three space-time dimensions the author explains, why this theory and its supersymmetric generalizations become integrable after the reduction to two dimensions considering as example colliding plane wave solutions of Einstein's field equations. Thereafter the group-theoretical structure of this theory is considered. (HSI).

**35363** (INS–879) **Future prospects of pregeometry.** Terazawa, Hidezumi. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Jun 1991. 19p. Order Number DE92704278. Source: OSTI; NTIS (US Sales Only); INIS.

Pregeometry is a theory, first suggested by Sakharov in 1967, in which gravity is taken as a quantum effect of matter fields and in which Einstein's theory of general relativity for gravity appears as an approximate and effective theory at long distances. It is shown by reviewing the extensive developments of pregeometric theories of gravity for the last more than a decade that the original idea by Sakharov is really working. Many future prospects of the theories are discussed in some detail. (author).

**35364** (JINR-D–4-89-221, pp. 13-17) **Geometric theory of gravitation.** Chernikov, N.A. (Joint Inst. for Nuclear Research, Dubna (USSR)). Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

The problem of geometric gravitation theory is discussed. An important geometric object - affine connection - is lost in the Einstein gravitation theory. It is noted that the detection of the lost object allows one to make the theory quite geometric. 1 ref.

**35365** (JINR-D–4-89-221, pp. 18-21) **On possible physical interpretation of Chernikov background connection.** Kapustsik, Eh. (Joint Inst. for Nuclear Research, Dubna (USSR)). Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

The message aim is to show that based on the recent Chernikov works it is possible to formulate a new gravitation theory which does not contain any constants in the basic equations. In this case the gravitation interaction constant occurs at the level of constitutive relations. 7 refs.

**35366** (JINR-D–4-89-221, pp. 22-29) **On integral energy conservation laws of gravitational field.** Tentyukov, M.N. (Joint Inst. for Nuclear Research, Dubna (USSR)). Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Tensor representations of certain energy-momentum pseudotensors of the gravitational field are considered. Gravitational field energy-momentum tensors appear to be background connection tensor functionals on a manifold with symmetric background affine connection. If the background connection is not metric them the local conservation laws are absent. Nevertheless a certain conserved integral value exists under certain conditions. 8 refs.

**35367** (JINR-D–4-89-221, pp. 38-41) **On symmetry principles in general relativity theory.** Pestov, A.B. (Joint Inst. for Nuclear Research, Dubna (USSR)). Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Properties of the second order nonlinear differential equation system symmetry $R_{ij}=0$, known as the Einstein gravitation law are discussed. It is shown that the gravitational field theory represents the topologic invariant theory. 2 refs.

**35368** (JINR-D–4-89-221, pp. 55-65) **Gravitational constant stability and the fifth interaction.** Mel'nikov, V.N. (Vsesoyuznyj Nauchno-Issledovatel'skij Tsentr po Izucheniyu Svojstv Poverkhnosti i Vakuuma, Moscow (USSR)); Radynov, A.G. Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

The problem of gravitation constant stability is discussed within the framework of the hypothesis of the fifth interaction existence. Possible time and spatial dependences of the gravitation constant are considered. The investigations conducted do not allow one to confirm or contradict the fact the fifth interaction existence. 6 refs.

**35369** (JINR-D–4-89-221, pp. 134-136) **Possibilities of experimental estimation of deviations from the Newton gravitation by interferometer methods.** Izmajlov, G.N. (Moskovskij Aviatsionnyj Inst., Moscow (USSR)); Nikolaev, F.A.; Ozolin, V.V. Joint Inst. for Nuclear Research, Dubna (USSR). 1989. (In Russian). (CONF-8810552–: Workshop on development and construction of gravitational wave emitter and detector, Dubna (USSR), 11-13 Oct 1988). In *Proceedings of workshop on the development and construction of gravitational wave emitter and detector.* 154p. Order Number DE92001311. Source: OSTI; NTIS (US Sales Only); INIS.

Laser interferometer application for measuring deviations from the Newton gravitation law is discussed. Estimation of the gravitation force measurement error makes up 0.025 %. 4 refs.; 1 fig.

**35370** (JINR-R–2-89-862) **Action of relativistic charge field.** Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy. 1989. 4p. (In Russian). Order Number DE92001314. Source: OSTI; NTIS (US Sales Only); INIS.

Based on the formula for the retarded intensity, results of calculations of the electric field created by a relativistic charge in the definite point are presented. Hence the duration of the field influence increases with the growth of a charge velocity. At the same time the field increasing outstrips the source. 3 refs., 3 figs.

**35371** (LA-UR–91-2283) **Diagnosis of nonlinear systems using time series analysis.** Hunter, N.F. Jr. Los Alamos National Lab., NM (United States). [1991]. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-911241–2: 3. international machinery monitoring and diagnostic conference, Las Vegas, NV (United States), 9-12 Dec 1991). Order Number DE91016041. Source: OSTI; NTIS; GPO Dep.

Diagnosis and analysis techniques for linear systems have been developed and refined to a high degree of precision. In contrast, techniques for the analysis of data from nonlinear systems are in the early stages of development. This paper describes a time series technique for the analysis of data from nonlinear systems. The input and response time series resulting from excitation of the nonlinear system are embedded in a state space. The form of the embedding is optimized using local canonical variate analysis and singular value decomposition techniques. From the state space model, future system responses are estimated. The expected degree of predictability of the system is investigated using the state transition matrix. The degree of nonlinearity present is quantified using the geometry of the transfer function poles in the z plane. Examples of application to a linear single-degree-of-freedom system, a single-degree-of-freedom Duffing Oscillator, and linear and nonlinear three degree of freedom oscillators are presented. 11 refs., 9 figs.

**35372** (LA-UR–91-2888) **A measurement of the gravitational acceleration of the antiproton: A status report.** Schecker, J.A. PS200 Collaboration. Los Alamos National Lab., NM (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910881–12: Particles and fields '91, Vancouver (Canada), 18-22 Aug 1991). Order Number DE92000368. Source: OSTI; NTIS; INIS; GPO Dep.

An experiment is being developed which will compare the acceleration, g, of the antiproton in the earth's gravitational field with that of $H^{minus}$ ions. This measurement will constitute the first direct test of the Weak Equivalence Principle (WEP) for antimatter. Low energy antiprotons from the LEAR facility at CERN will be decelerated, cooled and launched into a field free region, and the time of flight to a detector will determine g. The technical aspects of the experiment and our progress in the different areas are presented. 4 refs., 1 fig.

**35373** (UCRL-CR–107856) **Geometrically exact shells models: Foundation and computational aspects with special reference to implicit large-scale calculations.** Simo, J.C. (Stanford Univ., CA (United States)); Armero, F.; Miehe, C.; Laursen, T.; Taylor, R.L. Lawrence Livermore National Lab., CA (United States); Stanford Univ., CA (United States). Feb 1991. 23p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Grant 2-DJA-792. Order Number DE91019014. Source: OSTI; NTIS; GPO Dep.

A rigorous nonlinear stability analysis for a class of return mapping algorithms in elastoviscoplasticity based on the generalized mid-point rule is presented. In contrast with previous developments, the analysis is performed directly on the system of variational inequalities governing the problem and shown to hold for non-smooth convex elastic domains. To motivate the approach, a similar analysis is performed on the nonlinear heat-conduction equation. 35 refs.

**35374** (UCRL-ID–107112-Pt.2) **Irradiance compensation control for high-energy laser propagation: Part 2, Discrete actuator simulation.** Gavel, D.T. Lawrence Livermore National Lab., CA (United States). 18 Apr 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018489. Source: OSTI; NTIS; GPO Dep.

The quality of propagated Laser light strongly depends on the degree of phase uniformity across the beam at its source. When propagating through turbulent atmosphere, a Strehl ratio of nearly 0.9 is possible if phase correction is made at all spatial scales greater than approximately $r_o$, the Fried atmospheric cell size. Therefore $r_o$ is a reasonable choice for actuator spacing on the phase compensating adaptive optics. However, analysis of high energy laser propagation has shown that a control law designed to compensate only for atomspheric index fluctuations will drive thermal blooming instabilities. Small initial perturbations in beam irradiance will grow exponentially until the beam breaks up. Therefore it is necessary also to compensate for irradiance perturbations at the same spatial scale as the compensation for phase. Combined phase and irradiance compensation of an HEL has been shown to be stable in theory. Irradiance control can be accomplished with a pair of deformable mirrors spaced apart over a propagation path. Laser light reflected off of the first deformable mirror surface at $z = 0$ will result in magnitude perturbations some distance away at $z = L$. The second deformable mirror then recollimates the light. The purpose of simulating the irradiance compensation system is to test the baseline design in such a way that the effect of discrete actuator/sensors and beam edge effects is taken into account in a more realistic manner than can be performed by a 2-D fourier analysis. 7 refs., 9 figs.

**35375** (UCRL-JC–107319) **Broadband diffractive lens.** Ceglio, N.M. (Lawrence Livermore National Lab., CA (USA)); Hawryluk, A.M.; London, R.A.; Seppala, L.G.; Gaines, D.P. Lawrence Livermore National Lab., CA (United States). 28 May 1991. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911236–1: Optical Society of America (OSA) conference on short wavelength coherent radiation, Monterey, CA (United States), Dec 1991). Order Number DE91015186. Source: OSTI; NTIS; GPO Dep.

Significant progress has been made toward solving the century-old problem of chromatic aberrations in diffractive optics. Our approach exploits modern materials and microfabrication technology and is very different from the "purely diffractive strategy," which is commonly employed and which results in multiple diffractive elements separated by a finite distance. We have developed a Fresnel zone plate lens comprised of a serial stack of patterned minus-filters which allows broadband radiation to be focused (or imaged) without longitudinal or transverse chromatic aberrations. 7 refs., 4 figs.

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*Refer also to citation(s) 35310*

**35376** (DOE/ER/53279–1) **Plasma Science Committee (PLSC): Technical progress report, June 1, 1988–May 31, 1991.** National Academy of Sciences, Washington, DC (United States). Board on Physics and Astronomy. 17 Dec 1990. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-88ER53279. Order Number DE91018011. Source: OSTI; NTIS; INIS; GPO Dep.

The Plasma Science Committee (PLSC) is a standing committee under the auspices of the Board on Physics and Astronomy, Commission on Physical Sciences, Mathematics, and Applications of the National Academy of Sciences–National Research Council. Plasma sciences represent a broad and diverse field. The PLSC has accepted the responsibility of monitoring the continuing development and assessing the general health of the field as whole. Although select advisory bodies have been created to address specific issues that affect plasma science, such as the Fusion Policy Advisory Committee (FPAC), the PLSC provides a focus for the plasma science community that is unique and essential. The membership of the PLSC is drawn from research laboratories in universities, industry, and government. Areas of expertise on the committee include accelerators and beams, space physics, astrophysics, computational physics and applied mathematics, fusion plasmas, fundamental experiments and theory, radiation sources, low temperature plasmas, and plasma-surface interactions. The PLSC is well prepared to respond to requests for studies on specific issues. This report discusses ion of the PLSC work.

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*Refer also to citation(s) 35269, 35417, 35423, 35436, 35437, 35441, 35449, 35462, 35471, 35500, 35560*

**35377** (ANL/CP–73548) **Current profile control for ITER with rf current drive.** Ehst, D.A. (Argonne National Lab., IL (United States)); Pearlstein, D.L. Argonne National Lab., IL (United States). Aug 1991. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. (CONF-910869–5: 9. topical conference on radio frequency power in plasmas, Charleston, SC (United States), 12-14 Aug 1991). Order Number DE91018597. Source: OSTI; NTIS; INIS; GPO Dep.

Self-consistent MHD equilibria are found with the RIP computer code, which traces lower hybrid and fast wave rays in two dimensions; the tokamak flux surfaces are generated by LHCD, FWCD and the bootstrap effect. The bootstrap current dominates at the mid-minor radius, the FWCD provides the seed current and LHCD is effective only in the surface region of a fusion-grade tokamak. The bootstrap fraction maximizes by operating at high central safety factor, $q(0) \approx 2$, that is, with rather minimal FWCD; while the total current is effectively controlled by LHCD. There is potentially considerable flexibility to affect the current profile and MHD stability by appropriate adjustments to the RF power spectra. Current drive on ITER is more attractive at higher aspect ratios, and results are presented for A = 4.0. 6 refs.

**35378** (ANL/FPP/TM–256) **Inductive currents in an rf driven plasma.** Kinsey, J.; Ehst, D.A. Argonne National Lab., IL (United States). Fusion Power Program. Aug 1991. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE92000491. Source: OSTI; NTIS; INIS; GPO Dep.

Inductive effects are included in a self-consistent current drive model for axisymmetric tokamak plasmas used in the two-dimensional current drive/MHD equilibrium code, RIP. Previous simulations of current driven equilibria allowed for the steady-state calculation of bootstrap and RF currents. The addition of an inductive current is applied to enhance accurate design and interpretation of tokamak experiments. A convenient expression for the ohmic resistance in a tokamak plasma is derived to aid in the design of reactor grade MHD equilibria. 7 refs., 3 figs., 1 tab.

**35379** (CONF-910869–10) **ECH experiments on ATF.** Bigelow, T.S. (Oak Ridge National Lab., TN (United States)); Wilgen, J.B.; Baylor, L.R.; Murakami, M.; Schaich, C.R.; Lindley, R. Oak Ridge National Lab., TN (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. topical conference on radio frequency power in plasmas; Charleston, SC (United States); 12-14 Aug 1991. Order Number DE91018845. Source: OSTI; NTIS; INIS; GPO Dep.

Several electron cyclotron heating (ECH) experiments have been completed on the Advanced Toroidal Facility (ATF) at Oak Ridge National Laboratory (ORNL) under a variety of operating conditions and launch polarizations. ECH power is launched using a polarization-controlled beam launcher and microwave detectors are used to measure absorption of first-pass and multiply-reflected power. Measurements show that first-pass absorption efficiency at low plasma density is highly dependent on magnetic field, polarization, and plasma conditions. Wave polarization rotation has been detected, it is caused by the large magnetic field shear on ATF. Detector signals indicate that absorption efficiency is relatively high for medium plasma density at either fundamental or second harmonic operation. Plasmas have also been sustained using the third harmonic cyclotron resonance where absorption efficiency is much lower. Gyrotron power modulation and turn-off experiments have been performed to study power deposition and transport using plasma diagnostics. These experiments show that power absorption is fairly efficient. However, the power deposition profile is rather broad despite the relatively narrow launcher beam. This effect can be attributed to several factors including the broad extent of the resonant surface and the ~45% of power contained in both low-level sidelobes outside the launcher beam and in the wrong plasma mode. 3 refs., 3 figs.

**35380** (CONF-910869–13) **Full-wave calculation of fast-wave current drive in tokamaks including $k_{\|}$ upshifts.** Jaeger, E.F.; Batchelor, D.B. Oak Ridge National Lab., TN (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. topical conference on radio frequency power in plasmas; Charleston, SC (United States); 12-14 Aug 1991. Order Number DE92000048. Source: OSTI; NTIS; INIS; GPO Dep.

Numerical calculations of fast-wave current drive (FWCD) efficiency have generally been of two types: ray tracing or global wave calculations. Ray tracing shows that the projection of the wave number (k||) along the magnetic field can vary greatly over a ray trajectory, particularly when the launch point is above or below the equatorial plane. As the wave penetrates toward the center of the plasma, k|| increases, causing a decrease in the parallel phase speed and a corresponding decrease in the current drive efficiency, $\gamma$. But the assumptions of geometrical optics, namely short wavelength and strong single-pass absorption, are not greatly applicable in FWCD scenarios. Eigenmode structure, which is ignored in ray tracing, can play an important role in determining electric field strength and Landau damping rates. In such cases, a full-wave or global solution for the wave fields is desirable. In full-wave calculations such as ORION k|| appear as a differential operator $(\vec{B}\cdot\nabla)$ in the argument of the plasma dispersion function. Since this leads to a differential system of infinite order, such codes of necessity assume $k_{\|} \sim k_{\varphi}$ = const, where $k_{\varphi}$ is the toroidal wave number. Thus, it is not possible to correctly include effects of the poloidal magnetic field on k||. The problem can be alleviated by expressing the electric field as a superposition of poloidal modes, in which case k|| is purely algebraic. This paper describes a new full-wave calculation, Poloidal Ion Cyclotron Expansion Solution, which uses poloidal and toroidal mode expansions to solve the wave equation in general flux coordinates. The calculation includes a full solution for E|| and uses a reduced-order form of the plasma conductivity tensor to eliminate numerical problems associated with resolution of the very short wavelength ion Bernstein wave.

**35381** (CONF-910869–14) **Ray tracing and absorption of electron cyclotron waves in the L-2 stellarator.** Goldfinger, R.C. (Oak Ridge National Lab., TN (United States)); Likin, K.M.; Ochirov, B.D. Oak Ridge National Lab., TN (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. topical conference on radio frequency power in plasmas; Charleston, SC (United States); 12-14 Aug 1991. Order Number DE92000741. Source: OSTI; NTIS; INIS; GPO Dep.

The absorption of electron cyclotron waves in L-2 stellarator plasmas has been investigated by adapting the RAYS geometrical optics code developed at Oak Ridge National Laboratory to the parameters of L-2. Two heating schemes were considered: Low-field launching of the ordinary wave at the fundamental resonance and low-field launching of the extraordinary wave at the second harmonic. Significant power absorption (up to 100%) of the extraordinary mode at the second harmonic resonance was obtained. A multipass absorption model was used to estimate the contribution to plasma heating of the power that remains after the first pass which is subsequently reflected from the vessel walls. Finally, results obtained with the RAYS code and with a code developed at the Institute of Automation and Electrometry were compared and found to be in good agreement. 6 refs., 4 figs.

**35382** (CONF-9109200–1) **Full-wave calculation of fast-wave current drive in tokamaks including $k_{parallel}$ variations.** Jaeger, E.F; Batchelor, D.B. Oak Ridge National Lab., TN (United States). [1991]. 10p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International workshop on fast wave current drive in reactor scale tokamaks synergy and complementarity with LHCD and ECRH; Cadarache (France); 23-25 Sep 1991. Order Number DE92000076. Source: OSTI; NTIS; INIS; GPO Dep.

When fast waves propagate inward from the edge of a tokamak toward the plasma center, the $k_{\perp}$ spectrum produced by the antenna is not maintained but is shifted and deformed due to the presence of the finite poloidal magnetic field. This $k_{\perp}$ shift causes

a variation in the parallel phase speed of the wave and can therefore have a strong effect on electron damping and current drive efficiency. In this paper, we include this effect in a new full-wave calculation (PICES) which represents the wave fields as a superposition of poloidal modes, thereby reducing $k\perp$ to an algebraic operator. The wave equation is solved in general flux coordinates, including a full (non-perturbative) solution for $E\perp$ and a reduced-order dielectric formulation to eliminate short-wavelength ion Bernstein modes. A simplified current drive model which includes particle trapping is used to estimate the effect of the $k\perp$ shift on current drive efficiency in ITER and D3-D. Results suggest that when single-pass absorption is weak, reflected power may drive current nearly as efficiently as that absorbed on the first pass. 15 refs., 5 figs.

**35383** (DOE/ER/53198–180) **Measurement of magnetic fluctuations at small spatial scales in the Tokapole II tokamak.** Haines, E.J. Wisconsin Univ., Madison, WI (United States). Aug 1991. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER53198. Order Number DE92000161. Source: OSTI; NTIS; INIS; GPO Dep.

This thesis is a presentation of the measurements of short-wavelength, high-frequency radial magnetic fluctuations performed on the Tokapole 2 tokamak at the University of Wisconsin-Madison. Theories of electron temperature gradient ($\eta_e$) driven turbulence predict the existence of increased magnetic fluctuation power at small spatial scales near the collisionless skin depth $c/\omega_{pe}$ and over a wide range of frequencies near and below the electron diamagnetic drift frequency $\omega^*_{re}$. Small magnetic probes of sizes down to 1 m m have been constructed and used to resolve short poloidal and radial wavelength magnetic fluctuations. These probes have been used with larger probes to make comparisons of fluctuation spectra measured in various ranges of wavelength and over the range of frequencies from 10 kHz to 6 MHz in Tokapole 2 plasmas. A calculation of the short-wavelength, high-frequency response of an electrostatically shielded model $B_r$ probe has been performed to guide the interpretation of the power comparison measurements. Comparisons of magnetic fluctuation spectra at various positions within the plasma, and for discharges with edge safety factor 1, 2, and 3 are presented. The linear and nonlinear theories and numerical simulations of $\eta_e$ turbulence are reviewed and compared, where possible with the experimental parameters and results.

**35384** (DOE/ER/53198–181) **Manifestations of the MHD and kinetic dynamo through soft x-rays.** Chartas, G.A. Wisconsin Univ., Madison, WI (United States). Aug 1991. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER53198. Order Number DE92000162. Source: OSTI; NTIS; INIS; GPO Dep.

The underlying mechanisms that produce and sustain the reversed toroidal field in RFP's are investigated by analyzing 2Dx-ray emissivity reconstruction and by correlating the evolution of the hot electron properties to the reversed toroidal magnetic field. Reconnection of emissivity surfaces as seen in soft x-ray (SXR) reconstructing occur near the predicted resonant surface for the m=1, n=5, 6,-7 resistive tearing modes. Two distinct rates of reversed magnetic field generation are observed. First, in the MHD relaxation phase a sudden increase in $B_t(a)$ is detected. This event coincides with a large increase in the edge hot electron current density. The second mode of flux generation is observed t have a slower rate and occurs during the diffusion phase. A variation of the edge hot electron current density by a factor of four produced only a small change in the measured $B_t(a)$, implying the contributions of the hot electrons to the dynamo during the diffusion phase is small. $\tilde{T}_e$, $/<T_{e,hot}>$ was measured to be approximately 60%, which is much larger than the corresponding quantity for the bulk component which is about 30%. Scaling of the magnetic Reynolds number with the diffusion and MHD relaxation time, $\tau_{MHD}$ indicated that the $\tau_{MHD}$ does not have a strong dependence on the Spitzer resistivity whereas the diffusion time does depend on the classical resistivity. SXR emission mode analysis during the transition from a rotating to a locked plasma shows a decrease in the m=1 Fourier Bastille component of the emissivity. This is due to the flattening of the emissivity profile as seen in the SXR reconstructions.

**35385** (DOE/ER/53198–182) **Soft x-ray measurement of internal tearing mode structure in a reversed-field pinch.** Chartas, G.; Hokin, S. Wisconsin Univ., Madison, WI (United States). Dept. of Physics. 16 Sep 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER53198. Order Number DE92000164. Source: OSTI; NTIS; INIS; GPO Dep.

The structure of internally resonant tearing modes has been studied in the Madison Symmetric Torus reversed-field pinch with a soft x-ray detector system consisting of an imaging array at one toroidal location and several detectors at different toroidal locations. The toroidal mode numbers of m = 1 structures are in the range n = −5, −6, −7. The modes propagate with phase velocity v = 1–6 × $10^6$ cm/s, larger than the diamagnetic drift velocity $v_d \sim 5 \times 10^5$ cm/s. Phase locking between modes with different n in manifested as a beating of soft x-ray signals which is found to be strongest near the resonant surfaces of the modes (r/a = 0.1 – 0.5). 15 refs., 5 figs.

**35386** (DOE/ER/53207–6) **Application of modern mathematical concepts to plasma confinement: Progress report.** Cary, J.R. Colorado Univ., Boulder, CO (United States). Aug 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER53207. Order Number DE92000053. Source: OSTI; NTIS; INIS; GPO Dep.

Progress in three research areas has been achieved. (1) A new expression for the trapping probability for transitioning particles in asymmetric toroidal plasma confinement devices (e.g., stellarators and rippled tokamaks) has been derived. Comparison with numerical integrations shows that this new expression is more accurate than those of previous workers. (2) Simulations show that the dynamical enhancement of the turbulent diffusion coefficient over quasilinear observed in test particle simulations occurs also in selfconsistent plasma turbulence. (3) The simple method for calculating magnetic island widths discussed in the previous report has been published.

**35387** (DOE/ER/53223–169) **Plasma properties: Progress report, January 1, 1991–December 31, 1991.** Weitzner, H. New York Univ., NY (United States). Courant Inst. of Mathematical Sciences. Aug 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER53223. Order Number DE91018913. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics on plasma physics: kinetic modelling; fluid modelling; development of a non-maxwellian plasma transport theory; development of neoclassical theories near a tokamak edge; improvement of the usual neoclassical formula; ballooning modes; and the alfven spectrum. (LSP)

**35388** (DOE/ER/53256–1) **The optimization of production and control of hot-electron plasmas: Annual technical report.** Applied Microwave Plasma Concepts, Inc., Carlsbad, CA (United States). 11 Mar 1988. 46p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-87ER53256. Order Number DE91018740. Source: OSTI; NTIS; INIS; GPO Dep.

The research discussed in this paper consist of the following: Hot-Electron Plasma Formation in AMPHED; Kinectic Models of Hot-Electron Plasma Formation; Resonator Design and Tests; Results of 1-D Fokker-Planck ECH Study of TEXT; and AMPC/TEXT Collaboration.

**35389** (DOE/ER/53256–2) **The optimization of production and control of hot-electron plasmas.** Applied Microwave Plasma Concepts, Inc., Carlsbad, CA (United States). 17 Mar 1989. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-87ER53256. Order Number DE91018741. Source: OSTI; NTIS; INIS; GPO Dep.

The present project was initially undertaken to develop a number of innovative concepts for using electron cyclotron heating (ECH) to enhance tokamak performance. A common feature of the various applications under consideration is efficient, spatially-localized generation of hot-electron plasmas; and the first phase of the work addressed the basic aspects of an approach to achieving this Upper Off-Resonant Heating (UORH) and open-resonator couplers to confine the weakly damped microwave power to the particular region where the hot electrons are to be generated. The results of the first year's work provided strong evidence that hot-electron

plasmas with electron energies of hundreds of keV could be generated using multiple-frequency ECH and fully-toroidal open-resonator couplers. The evidence was sufficiently compelling to suggest that the project be focused on a suitable near-term application to the TEXT device.

35390 (DOE/ER/53256–3) **The optimization of production and control of hot-electron plasmas: Annual technical report.** Applied Microwave Plasma Concepts, Inc., Carlsbad, CA (United States). 29 Jun 1990. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-87ER53256. Order Number DE91018742. Source: OSTI; NTIS; INIS; GPO Dep.

The present project was initially undertaken to develop a number of innovative concepts for using electron cyclotron heating (ECH) to enhance tokamak performance. For example, since the efficiency of steady-state RF current drive increases linearly with the energy of the current carrier, the recirculating power needed to sustain tokamak reactors can be reduced to attractive values if the current is carried by a small minority group of superthermal electrons. Again, it has been predicted that the high-beta second regime of stable tokamak operation could be reached if layers of energetic electrons could be formed during the startup. It is also possible to use ECH to suppress MHD modes, including sawteeth and internal kinks, and to modify ambipolar potentials for enhanced confinement. A common element of these concepts is the efficient, spatially-localized generation of hot-electron plasmas. The first phase of the work investigated an approach to achieving this under Upper Off-Resonant Heating and open-resonator couplers to confine the weakly damped microwave power to the particular region where the hot electrons are to be generated. The results of the first year's work provided strong evidence that hot-electron plasmas with electron energies of hundreds of keV could be generated using multiple-frequency ECH and toroidal open-resonator couplers. The evidence was sufficiently compelling to suggest that the project be focused on a suitable near-term application to the TEXT device.

35391 (DOE/ET/53088–518) **Continuum damping of high mode number toroidal Alfven waves.** Rosenbluth, M.N. (California Univ., San Diego, La Jolla, CA (United States). Dept. of Physics); Berk, H.L.; Lindberg, D.M.; Van Dam, J.W. Texas Univ., Austin, TX (United States). Inst. for Fusion Studies. Aug 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG05-80ET53088 ;FG03-88ER53275. (IFSR–518). Order Number DE91018891. Source: OSTI; NTIS; INIS; GPO Dep.

An asymptotic theory is developed to determine the continuum damping of short-wavelength Toroidal Alfven Eigenmodes, which is essential for ascertaining thresholds for alpha particle driven instability in ignited tokamaks. 9 refs., 1 fig. 1 tab.

35392 (GA-A–20614) **The multipulse Thomson scattering diagnostic on the DIII-D tokamak.** Carlstrom, T.N.; Campbell, G.L.; DeBoo, J.C.; Evanko, R.G.; Evans, J.; Greenfield, C.M.; Haskovec, J.S.; Hsieh, C.L.; McKee, E.L.; Snider, R.T.; Stockdale, R.E.; Thomas, M.P.; Trost, P.K. General Atomics, San Diego, CA (United States). Sep 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-910968–5: 14. IEEE symposium on fusion engineering, San Diego, CA (United States), 30 Sep - 3 oct 1991). Order Number DE92000262. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the design and operation of a 40-spatial channel Thomson scattering system that uses multiple 20 Hz Nd:YAG lasers to measure the electron temperature and density profiles periodically throughout an entire plasma discharge. Interference filter polychromators disperse the scattered light which is detected by silicon avalanche photodiodes. The measurable temperature range from 10 eV to 20 keV and the minimum detectable density is about $2 \times 10^{18}$ $m^{-3}$. Laser control and data acquisition are performed in real-time by a VME-based microcomputer. Data analysis is performed by a MicroVAX 3400. Unique features of this system include "burst mode" operation, where multiple lasers are fired in rapid succession (< 10 KHz), real-time analysis capability, and laser beam quality and alignment monitoring during plasma operation. Results of component testing, calibration, and plasma operation are presented. 8 refs. 6 figs.

35393 (GSI–91-24) **Investigation of the energy loss and the charge state of high energy heavy ions in a hydrogen plasma.** Dietrich, K.G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany); Heidelberg Univ. (Germany). Jul 1991. 84p. (In German). Order Number DE92714362. Source: OSTI; NTIS (US Sales Only); INIS.

For heavy ions with energy of 1.4 to 5.9 MeV/u the energy loss and charge state after transmission through a totally ionized hydrogen plasma are investigated. Plasma target was a Z-pinch device incorporated in the beam optics of the accelerator by a pumping system. In the 20 cm long pinch hydrogen plasmas with densities up to $1.5 \times 10^{19}$ $cm^{-3}$ and temperatures above 5 eV are produced, with ionization efficiency higher than 99%. The ions pass the plasma on the symmetry axis of the plasma column through small apertures in the electrodes. The energy loss was measured by time-of-flight method, the plasma density by interferometry along the pinch axis. For the first time the ion charge after transmission through the plasma has been determined by a charge spectrometer being a combination of a dipole magnet and a position sensitive detector with high time resolution. A growth of the average charge of heavy ions in plasma higher than the equilibrium charge in cold gas was discovered, caused by a reduction of electron capture by fast heavy ions in ionized matter. The electron loss rates in plasma and cold gas are equal. (orig./AH).

35394 (IPP–2/312) **On the existence and uniqueness of dissipative plasma equilibria in a toroidal domain.** Spada, M.; Wobig, H. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Jun 1991. 28p. Order Number DE92714339. Source: OSTI; NTIS (US Sales Only); INIS.

A one-fluid, dissipative magnetohydrodynamic model of plasma equilibrium in a torus is considered. The equations include inertial forces, finte resistivity and viscosity, and a particle source which sustains the pressure gradient in the plasma; viscosity is described by the Braginskii operator. Plasma density, resistivity and viscosity coefficients are assumed to be uniform. A boundary-value problem in a general toroidal domain is formulated, no further assumption on the domain being made besides a sufficient regularity of its boundary. The system of equations is reduced to a problem with unknowns p, v, B (p denotes the scalar pressure, v the flow velocity, B the magnetic field). A functional setting of the equations is established and, generalizing the classical mathematical techniques adopted in the theory of viscous incompressible flow to investigate the solvability of the steady-state Navier-Stokes equations, a problem for weak solutions is formulated which is shown to be equivalent to solving a nonlinear equation in a separable Hilbert space. Then, by analysing the Braginskii viscosity in the established functional framework, we find properties which allow to write the above equation as a fixed-point equation. Main results of our analysis are the following: (i) We prove the existence of at least one weak solution if the source is sufficiently small, or viscosity and resistivity sufficiently large; (ii) We obtain an estimate of the solution(s); (iii) We prove that, under a condition of the same kind as that for existence, but more stringent, there exists only one solution; (iv) The well known existence and uniqueness results for the steady-state Navier-Stokes problem are recovered when the magnetic field is set equal to zero. (orig.).

35395 (IPP–4/246) **Steady-state operation requirements of tokamak fusion reactor concepts.** Knobloch, A.F. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Jun 1991. 48p. Order Number DE92714340. Source: OSTI; NTIS (US Sales Only); INIS.

In the last two decades tokamak conceptual reactor design studies have been deriving benefit from progressing plasma physics experiments, more depth in theory and increasing detail in technology and engineering. Recent full-scale reactor extrapolations such as the US ARIES-I and the EC Reference Reactor study provide information on rather advanced concepts that are called for when economic boundary conditions are imposed. The ITER international reactor design activity concentrated on defining the next step after the JET generation of experiments. For steady-state operation as required for any future commercial tokamak fusion power plants it is essential to have non-inductive current drive. The current drive power and other internal power requirements specific to magnetic

confinement fusion have to be kept as low as possible in order to attain a competitive overall power conversion efficiency. A high plasma Q is primarily dependent on a high current drive efficiency. Since such conditions have not yet been attained in practice, the present situation and the degree of further development required are characterized. Such development and an appropriately designed next-step tokamak reactor make the gradual realization of high-Q operation appear feasible. (orig.).

**35396** (IPP–6/298) **Localization of modes in media with simple quasiperiodic modulation.** Salat, A. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Jun 1991. 25p. Order Number DE92714301. Source: OSTI; NTIS (US Sales Only); INIS.

The spectrum and the solutions of the 1-D Schroedinger equation with a quasiperiodic potential V are investigated numerically. Quasiperiodicity in contrast to periodicity makes possible the localization of modes. V is taken as the sum of two incommensurate periodic $\delta$-function series. The spectrum consists of bands separated by gaps which correspond to plateaus in the winding number. The spectrum of extended solutions (three-frequency-quasiperiodic) is found from the initial value problem. Localized solutions cannot be found in this way, owing to numerical instability. Instead, localized solutions (exponential decay on both sides) and the concomitant point spectrum are obtained from a boundary value method. An alternative method to find the point spectrum for bounded potentials is proved valid also for $\delta$-function potentials, as used here. Connections with the MHD spectrum of toroidal plasmas and Alfven wave heating are pointed out. (orig.).

**35397** (IPP–III/175) **Tomographical investigation of internal disruptions in the tokamaks ASDEX and TFTR.** Buechse, R. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Apr 1991. 115p. (In German). Order Number DE92714342. Source: OSTI; NTIS (US Sales Only); INIS.

The subject of this work is the investigation of the most important MHD-instability, the so-called 'internal disruption' or 'sawtooth instability' in the center of a tokamak by tomographical analysis of the soft X radiation. Only plasmas heated by neutral atom beam injection are examined, where momentum transfer causes a toroidal plasma rotation. After magnetohydrodynamics and sawtooth oscillations, plasma radiation, the experimental construction of the soft X radiation diagnostics and the used methods of tomography, the experimental results of sawtooth oscillations in ASDEX and TFTR tokamaks are discussed and summarized. (orig.).

**35398** (IPP–III/176) **Characterization of edge plasma fluctuations in ASDEX.** Qin, J. (Academia Sinica, Beijing (China). Inst. of Physics); Carlson, A.; Endler, M.; Giannone, L.; Niedermeyer, H.; Rudyj, A.; Theimer, G. ASDEX Team. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Apr 1991. 21p. Order Number DE92714300. Source: OSTI; NTIS (US Sales Only); INIS.

Nonlinear dynamical characterizations of the edge plasma fluctuations measured by both $H_\alpha$-light diagnostic and Langmuir probes in ASDEX are presented. The edge plasma fluctuations are stochastic rather than chaotic, they have a higher-dimensional structure in phase space. In time, the edge turbulence is found to have memory properties, the time required to lose the memory is different in the different cases. (orig.).

**35399** (IPP–III/177) **Investigation of the plasma bremsstrahlung in the near infrared for $Z_{eff}$ determination and electron density feedback control in tokamak devices.** Kurzan, B. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Oct 1990. 69p. (In German). Order Number DE92714327. Source: OSTI; NTIS (US Sales Only); INIS.

In the ASDEX Thomson scattering system the scattered light of a Nd:YAG laser beam ($\lambda$ = 1064 nm) is measured to obtain electron density and temperature profiles every 16 ms. The same system is continuously used to measure bremsstrahlung in the near infrared, allowing determination of radial $Z_{eff}$ profiles. Furthermore, the diagnostic can also be used for real time control of the electron density. This applies in particular in cases where large sawteeth and pellet injection generate counting errors in the interferometer signal. The relation between the line density n and the central chord bremsstrahlung signal $U_b$ was investigated for different heating scenarios in a wide density range. (orig.).

**35400** (IPP–III/180) **ASDEX contributions to the 18th European conference on controlled fusion and plasma heating.** Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Jun 1991. 150p. (CONF-9106293–: 18. European conference on controlled fusion and plasma heating, Berlin ( G is not a valid Country Code.), 3-7 Jun 1991). Order Number DE92714653. Source: OSTI; NTIS (US Sales Only); INIS.

Impurity transport and neoclasscial predictions; confinements studies; H-mode studies; density limit studies; lower hybrid and ICRH; impurity and divertor studies; diagnostics. (orig./AH).

**35401** (Juel–2423) **Longitudinal transport coefficients of a magnetized plasma consisting of hydrogen and a single impurity element in arbitrarily populated charge states.** Claassen, H.A. (Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Plasmaphysik); Gerhauser, H.; El-Sharif, R.N. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Plasmaphysik. Jan 1991. 53p. Order Number DE92711173. Source: OSTI; NTIS (US Sales Only); INIS.

The coefficients determining the transport processes along the magnetic field in a magnetized plasma consisting of electrons, protons/deuterons and impurity ions in various charge states have been calculated on the basis of Grad's 21 moment approximation. Assuming a single impurity element, the determinants appearing in the transport coefficients are evaluated analytically for arbitrary ratios $m_z/m_+$ between the impurity and hydrogen masses. The general formulae are then simplified for the important case $m_z/m_+ \geq 1$ and compared with existing data given by V.M. Zhdanov et al. and Yu.L. Igitkhanov et al. Whereas with minor modifications the proton/deuteron and electron coefficients agree well, there are remarkable differences in the impurity ion transport coefficients, which are discussed. (orig.).

**35402** (Juel–2432) **Investigation of E x B transport with a multi-electrode probe in the plasma boundary of TEXTOR. First results.** Ivanov, R.S. (AN SSSR, Moscow (USSR). Inst. Vysokikh Temperatur); Bora, D.; Moyer, R.A.; Nieuwenhove, R. van; Oost, G. van; Fuchs, G.; Hoethker, K.; Samm, U. Forschungszentrum Juelich GmbH (Germany). Inst. fuer Plasmaphysik. Jan 1991. 51p. Order Number DE92711172. Source: OSTI; NTIS (US Sales Only); INIS.

A movable multi-element Langmuir probe was implemented in TEXTOR in order to study properties of the edge and scrape-off plasma. The probe has five graphite electrode pins allowing the simultaneous measurement of main parameters such as plasma densities, electron temperatures, floating potentials, poloidal and radial electric fields. Both time-averaged and fluctuating quantities have been considered in order to evaluate the DC and turbulence-driven cross-field particle fluxes. The spectral analysis of the fluctuating floating potentials at spatially separated probe pins allows to determine the velocity associated with the rotations of the boundary plasma. The investigations have been focused on the variations of plasma boundary properties in plasmas with pure ohmic heating as well as auxiliary heating (ICRH). Special attention has been paid to the change of transport properties with the transition to a detached plasma. In particular, a significant reduction of the poloidal phase velocity at the limited edge has been observed for detached plasmas. Preliminary data on physical effects near the plasma boundary, which occur when the toroidal belt limiter (ALT-II) is biased, are reported. (orig.).

**35403** (KFTI–89-13) **Nonlinear Landau damping in a cross magnetic field.** Bulatova, R.F.; Onishchenko, I.N. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 9p. (In Russian). Order Number DE91643139. Source: OSTI; NTIS (US Sales Only); INIS.

Method of particle computerized simulation was used to study the effect of a cross magnetic field on Landau damping. It is shown that nonlinear decrement of plasma wave damping is maximal at $\omega_b$tau~1 $\omega$-cyclotron frequency; tau-period of captured particle oscillations.

**35404** (LA-UR–91-2860) **Energetic alpha particle deposition in a magnetized plasma.** Smitherman, D.P.; Kirkpatrick, R.C. Los Alamos National Lab., NM (United States). [1991]. 6p. Sponsored

by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910626–13: 6. international conference on emerging nuclear energy systems, Monterey, CA (United States), 16-21 Jun 1991). Order Number DE92000316. Source: OSTI; NTIS; INIS; GPO Dep.

The problem of energetic alpha particle deposition in a dense, magnetized deuterium-tritium (DT) thermonuclear fuel has been studied numerically for the case of coulomb interactions in cylindrical geometry. This was done by following the particle trajectories initiated at various radii and in different directions through the plasma and its imposed field until they had either left the plasma or deposited all their energy. The resulting complex particle trajectories in the static magnetized fuel make a detailed treatment of the problem computationally intensive. Therefore, we have attempted to use detailed modeling to produce a data base for a neural nets algorithm for incorporation in an ignition critical profile code. While the accuracy of the neutral net in reproducing the detailed calculational results is not high, it is approximately 6000 times faster. 7 refs., 1 fig.

**35405** (NIFS–83) **Density peaking in the JFT-2M tokamak plasma with counter neutral beam injection.** Ida, K. (and others); Itoh, S.; Itoh, K. National Inst. for Fusion Science, Nagoya (Japan). May 1991. 22p. Order Number DE92713934. Source: OSTI; NTIS (US Sales Only); INIS.

A significant particle pinch and reduction of the effective thermal diffusivity are observed after switching the neutral beam direction from co- to counter- injection in the JFT-2M tokamak. A time delay in the occurrence of density peaking to that of plasma rotation is found. This shows that the particle pinch is related to the profile of the electric field as determined by the plasma rotation profile. The measured particle flux shows qualitative agreement with the theoretically-predicted inward pinch. (author).

**35406** (NIFS–86) **Geometrical effects of the magnetic field on the neoclassical flow, current and rotation in general toroidal systems.** Nakajima, N.; Okamoto, M. National Inst. for Fusion Science, Nagoya (Japan). May 1991. 34p. Order Number DE92713937. Source: OSTI; NTIS (US Sales Only); INIS.

In order to clarify geometrical effects of the magnetic field on neoclassical theory, the neoclassical parallel particle flow, heat flux, current and plasma rotation of a multispecies plasma in general toroidal systems are examined in several collisionality regimes. The quantitative and qualitative differences between axisymmetric (tokamaks) and non-axisymmetric toroidal systems (stellarator, heliotron/torsatron) appear mainly through a geometrical factor which prescribes the parallel flow due to the gradients of the density, temperature, and electrostatic potential. In axisymmetric toroidal systems the geometrical factor reduces to the same expression in all collisionality regimes due to axisymmetry. By contrast, in non-axisymmetric toroidal systems, it changes drastically depending on the magnetic fieled structure and the collisionality regime. Thus, the poloidal flow has the radial electric field dependence. When the geometrical factor is very small, the ion parallel flow almost vanishes and the ion rotation consists of the diamagnetic and E vector x B vector flows (perpendicular flows). (author).

**35407** (NIFS–87) **ELMy-H mode as limit cycle and chaotic oscillations in tokamak plasmas.** Itoh, Sanae; Itoh, Kimitaka; Fukuyama, Atsushi; Miura, Yukitoshi. National Inst. for Fusion Science, Nagoya (Japan). May 1991. 20p. Order Number DE92713938. Source: OSTI; NTIS (US Sales Only); INIS.

A model of Edge Localized Modes (ELMs) in tokamak plasmas is presented. A limit cycle solution is found in the transport equation (time-dependent Ginzburg-Landau type), which a has hysteresis curve between the gradient and flux. Periodic oscillation of the particle outflux and L/H intermediate state are predicted near the L/H transition boundary. A mesophase in spatial structure appears near edge. Chaotic oscillation is also predicted. (author).

**35408** (NIFS–89) **Nonlinear behavior of multiple-helicity resistive interchange modes near marginally stable states.** Sugama, Hideo; Nakajima, Noriyoshi; Wakatani, Masahiro. National Inst. for Fusion Science, Nagoya (Japan). May 1991. 35p. Order Number DE92713940. Source: OSTI; NTIS (US Sales Only); INIS.

Nonlinear behavior of resistive interchange modes near marginally stable states is theoretically studied under the multiple-helicity condition. Reduced fluid equations in the sheared slab configuration are used in order to treat a local transport problem. With the use of the invariance property of local reduced fluid model equations under a transformation between the modes with different rational surfaces, weakly nonlinear theories for single-helicity modes by Hamaguchi and Nakajima are extended to the multiple-helicity case and applied to the resistive interchange modes. We derive the nonlinear amplitude equations of the multiple-helicity modes, from which the convective transport in the saturated state is obtained. It is shown how the convective transport is enhanced by nonlinear interaction between modes with different rational surfaces compared with the single-helicity case. We confirm that theoretical results are in good agreement with direct numerical simulations. (author).

**35409** (NIFS–90) **Radial transport induced by rotating RF fields and breakdown of intrinsic ambipolarity in a magnetic mirror.** Hojo, Hitoshi (Tsukuba Univ., Ibaraki (Japan). Plasma Research Center); Hatori, Tadatsugu. National Inst. for Fusion Science, Nagoya (Japan). Jun 1991. 17p. Order Number DE92713941. Source: OSTI; NTIS (US Sales Only); INIS.

Radial transport induced by rotating RF fields in a magnetic mirror is studied. The used RF frequency is in the ion cyclotron range of frequency and also comparable to the electron bounce frequency. The radial particle fluxes for ions and electrons are obtained by use of the gyrokinetic equation. With a positive azimuthal mode number of the RF field, the radial particle flux is outward for Maxwellian ions and is inward for Maxwellian electrons. This shows that the intrinsic ambipolarity is broken in this RF-induced transport. The present analysis can be applied to the thermal-barrier pumping of a tandem mirror. (author).

**35410** (NIFS-PROC–5, pp. 21-33) **Experiments toward the development of new pulsed ion diodes.** Horioka, Kazuhiko (Tokyo Inst. of Tech. (Japan)); Tazima, Naoki; Saito, Yasuhiro; Kasuya, Koichi. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185–: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications.* 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

Laser-based diagnostic methods are developed to improve our understanding of the behavior of a flashover-type magnetically-insulated, pulsed-ion diode. Effects of neutral particles on the diode characteristics are examined with laser resonant interferometry. For the quantitative estimation of the particle density, a laser resonance scattering method is also applied. These techniques could allow direct determination of the particle distribution in the diode gap. A new diode which uses actively produced source plasma is developed for the investigation of the anode plasma effect on the diode characteristics. Two types of diode configurations are tested, over a wide range of pulse delays and peak flux of the source plasma injection. (author).

**35411** (ORNL–6624) **Fusion Energy Division annual progress report, period ending December 31, 1989.** Sheffield, J.; Baker, C.C.; Saltmarsh, M.J. Oak Ridge National Lab., TN (United States). Jul 1991. 316p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000388. Source: OSTI; NTIS; INIS; GPO Dep.

The Fusion Program of Oak Ridge National Laboratory (ORNL) carries out research in most areas of magnetic confinement fusion. The program is directed toward the development of fusion as an energy source and is a strong and vital component of both the US fusion program and the international fusion community. Issued as the annual progress report of the ORNL Fusion Energy Division, this report also contains information from components of the Fusion Program that are carried out by other ORNL organizations (about 15% of the program effort). The areas addressed by the Fusion Program and discussed in this report include the following: Experimental and theoretical research on magnetic confinement concepts, engineering and physics of existing and planned devices, including remote handling, development and testing of diagnostic

tools and techniques in support of experiments, assembly and distribution to the fusion community of databases on atomic physics and radiation effects, development and testing of technologies for heating and fueling fusion plasmas, development and testing of superconducting magnets for containing fusion plasmas, development and testing of materials for fusion devices, and exploration of opportunities to apply the unique skills, technology, and techniques developed in the course of this work to other areas. Highlights from program activities are included in this report.

**35412** (UCLA/PPG–1200-Vol.2) **The TITAN reversed-field-pinch fusion reactor study: Final report, 1990: Volume 2, TITAN plasma engineering.** California Univ., Los Angeles, CA (United States); General Atomics, San Diego, CA (United States); Los Alamos National Lab., NM (United States); Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Nuclear Engineering. 1990. 431p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER52126 ;AC03-84ER53158 ;FG02-85ER52118 ;W-7405-ENG-36. Order Number DE92000140. Source: OSTI; NTIS; INIS; GPO Dep.

This paper on titan plasma engineering contains papers on the following topics: reversed-field pinch as a fusion reactor; parametric systems studies; magnetics; burning-plasma simulations; plasma transient operations; current drive; and physics issues for compact RFP reactors.

**35413** (UCRL-ID–108042) **Electromagnetic plasma simulation in realistic geometries.** Brandon, S.; Ambrosiano, J.; Nielsen, D. Lawrence Livermore National Lab., CA (United States). 1 Aug 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91018651. Source: OSTI; NTIS; GPO Dep.

Particle-in-Cell (PIC) calculations have become an indispensable tool to model the nonlinear collective behavior of charged particle species in electromagnetic fields. Traditional finite difference codes, such as CONDOR (2-D) and ARGUS (3-D), are used extensively to design experiments and develop new concepts. A wide variety of physical processes can be modeled simply and efficiently by these codes. However, experiments have become more complex. Geometrical shapes and length scales are becoming increasingly more difficult to model. Spatial resolution requirements for the electromagnetic calculation force large grids and small time steps. Many hours of CRAY YMP time may be required to complete 2-D calculation – many more for 3-D calculations. In principle, the number of mesh points and particles need only to be increased until all relevant physical processes are resolved. In practice, the size of a calculation is limited by the computer budget. As a result, experimental design is being limited by the ability to calculate, not by the experimenters ingenuity or understanding of the physical processes involved. Several approaches to meet these computational demands are being pursued. Traditional PIC codes continue to be the major design tools. These codes are being actively maintained, optimized, and extended to handle large and more complex problems. Two new formulations are being explored to relax the geometrical constraints of the finite difference codes. A modified finite volume test code, TALUS, uses a data structure compatible with that of standard finite difference meshes. This allows a basic conformal boundary/variable grid capability to be retrofitted to CONDOR. We are also pursuing an unstructured grid finite element code, MadMax. The unstructured mesh approach provides maximum flexibility in the geometrical model while also allowing local mesh refinement. Both innovative approaches to electromagnetic PIC calculations are generalizable to 3-D.

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*Refer also to citation(s) 34039, 34449, 34582, 34583, 35259, 35379, 35389, 35390, 35410, 35411, 35412*

**35414** (CONF-8906112–, pp. 25-32) **Self shielding of surfaces irradiated by intense energy fluxes.** Varghese, P.L. (Univ. of Texas, Austin (USA)); Howell, J.R.; Chen, Y.K.; Bakshi, V.; Propp, A.; Tan, Z.; Harden, B. Argonne National Lab., IL (United States). [1989]. DOE Contract FG05-87ER13735. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

This paper describes the experimental studies and associated numerical modelling of the interaction between a target and high speed, high temperature plasmas produced by a rail gun. Preliminary experimental results are presented. Brief descriptions are given of a new numerical technique for computing the collision integral of the Boltzmann equation which was developed. A two-dimensional numerical model for flow fields with coupled radiation from an emitting, absorbing, and scattering flow medium is also described.

**35415** (CONF-910869–7) **Results of folded waveguide tests on RFTF.** Baity, F.W.; Bigelow, T.S.; Carter, M.D.; Gardner, W.L.; Goulding, R.H.; Haste, G.R.; Hoffman, D.J.; Sparks, D.O. Oak Ridge National Lab., TN (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. topical conference on radio frequency power in plasmas; Charleston, SC (United States); 12-14 Aug 1991. Order Number DE91018930. Source: OSTI; NTIS; INIS; GPO Dep.

Experiments with the 80-MHz prototype folded waveguide on the Radio-Frequency Test Facility (RFTF) at Oak Ridge National Laboratory have achieved substantially higher power levels than any previous tests on comparably sized loop antennas. This result, combined with a superior wave spectrum, suggests that the folded waveguide should be capable of several times the power flux of a loop antenna into a tokamak plasma. 6 refs., 2 figs.

**35416** (CONF-910869–9) **Calculation of rf power dissipation in Faraday shield tubes.** Ryan, P.M.; Goulding, R.H.; Haste, G.R.; Hoffman, D.J. Oak Ridge National Lab., TN (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. topical conference on radio frequency power in plasmas; Charleston, SC (United States); 12-14 Aug 1991. Order Number DE91018865. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. SHIELDING/dissipation factor; SHIELDING/power distribution; RF SYSTEMS; SHIELDING; TUBES; POWER DENSITY; CALCULATION METHODS; IMPEDANCE; ANTENNAS

**35417** (CONF-910869–11) **Three-dimensional calculations of fields and loading for loop and folded waveguide ICRF antennas.** Carter, M.D.; Baity, F.W.; Batchelor, D.B.; Hoffman, D.J.; Jaeger, E.F.; Swain, D.W.; Haste, G.R. Oak Ridge National Lab., TN (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. topical conference on radio frequency power in plasmas; Charleston, SC (United States); 12-14 Aug 1991. Order Number DE92000065. Source: OSTI; NTIS; INIS; GPO Dep.

The ANT and ORION codes have been combined and used to study the loading of various antenna geometries with simple three-dimensional (3-D) effects. Both codes use a slab model with periodic Fourier analysis for modeling the toroidal and poloidal directions. The ANT code is used to prescribe current sets in a vacuum region where the field solutions are obtained analytically of each Fourier mode and matching conditions are used at poloidal/toroidal current sheet locations. Multiple current sheets are permitted and various feeder options are available to model the radial antenna currents. Current elements maybe oriented at arbitrary angles to the static magnetic field and may be independently phased in time. The fields at the plasma surface are prescribed by an impedance matrix for each Fourier mode. The ORION code solves for the fields in the plasma region using finite difference techniques, a plasma dispersion relation that retains the lowest-order finite gyroradius effects, and all three electric field components. Results are presented for a folded waveguide mock-up and for a loop antenna design under identical plasma conditions.

**35418** (CONF-910869–12) **Design and performance of fast wave current drive systems in the ICRF.** Goulding, R.H. (Oak Ridge National Lab., TN (United States)); Baity, R.W.; Batchelor, D.B.; Carter, M.D.; Jaeger, E.F.; Hoffman, D.J.; Ryan, P.M.; Tolliver, J.S.; Mayberry, M.J.; Petty, C.C.; Pinsker, R.I.; Prater, R. Oak Ridge National Lab., TN (United States). [1991]. 19p. Sponsored

by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 9. topical conference on radio frequency power in plasmas; Charleston, SC (United States); 12-14 Aug 1991. Order Number DE92000050. Source: OSTI; NTIS; INIS; GPO Dep.

Experiments have begun on D3-D using the fast wave current drive (FWCD) phased antenna array. The array consists of four elements with slotted septa between them to reduce mutual coupling. The passive phasing/matching circuit developed for the launcher incorporates only five tuning elements and is driven by a single rf power supply. The system has successfully operated in the presence of plasma at power levels up to 1.25 MW, with $\pi/2$ relative phasing, and approximately equal currents and voltages on all elements. Tuning algorithms that allow proper setting of all five elements within 1–2 shots have been developed. In addition, substantial modeling has been undertaken in support of the D3-D FWCD program. Loading calculations that take into account currents induced in the septa as well as other effects related to antenna geometry have been performed, and the results agree well with the observed data. A circuit model has been developed that, in combination with the loading calculations, allows the simulation of shot-to-shot matching for various tuning algorithms. 6 refs., 8 figs.

**35419** (CONF-910968–2) **Characteristics of an electron-beam rocket pellet accelerator.** Tsai, C.C.; Foster, C.A.; Milora, S.L.; Schechter, D.E. Oak Ridge National Lab., TN (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000073. Source: OSTI; NTIS; INIS; GPO Dep.

A proof-of-principle (POP) electron-beam pellet accelerator has been developed and used for accelerating hydrogen and deuterium pellets. An intact hydrogen pellet was accelerated to a speed of 460 m/s by an electron beam of 13.5 keV. 0.3 A, and 2 ms. The maximum speed is limited by the acceleration path length (0.4 m) and pellet integrity. Experimental data have been collected for several hundred hydrogen pellets, which were accelerated by electron beams with parameters of voltage up to 16 kV, current up to 0.4 A, and pulse length up to 10 ms. Preliminary results reveal that the measured burn velocity increases roughly with the square of the beam voltage, as the theoretical model predicts. The final pellet velocity is proportional to the exhaust velocity, which increases with the beam power. To reach the high exhaust velocity needed for accelerating pellets to >1000 m/s, a new electron gun, with its cathode indirectly heated by a graphite heater and an electron beam, is being developed to increase beam current and power. A rocket casing or shell around the pellet has been designed and developed to increase pellet strength and improve the electron-rocket coupling efficiency. We present the characteristics of this pellet accelerator, including new improvements. 13 refs., 6 figs.

**35420** (CONF-910968–7) **The ion cyclotron heating (ICH) system for BPX.** Swain, D.W.; Yugo, J.J.; Williamson, D.E.; Batchelor, D.B.; Carter, M.D.; Goulding, R.H. Oak Ridge National Lab., TN (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000426. Source: OSTI; NTIS; INIS; GPO Dep.

The ICH system is required to deliver at least 20 MW of rf power to the BPX plasma for pulse lengths of up to 15 s over a range of plasma operating conditions (e.g., average plasma densities from 0.5 to 4.5 x $10^{20}$ $m^{-3}$, toroidal fields from 5 to 8 T). The power must be delivered to the plasma over a range of frequencies corresponding to the different operating conditions. On the basis of calculations of the load resistance that the antennas will see because of the presence of the plasma, circuit analysis of the rf system indicates that the present ICH design should easily be able to deliver this amount of power to the plasma. Some research and development (R&D) must be done to provide a reliable system in the BPX radiation environment. 5 refs., 9 figs., 1 tab.

**35421** (CONF-910968–8) **Ex-vessel remote maintenance development plans for the Burning Plasma Experiment.** Burgess, T.W.; Davis, F.C. Oak Ridge National Lab., TN (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000430. Source: OSTI; NTIS; INIS; GPO Dep.

Remote maintenance (RM) is fundamental to the basic design requirements of the Burning Plasma Experiment (BPX), and an extensive RM development and demonstration program is planned to meet these requirements. The program first draws from the experience base that exists in the fission community and Europe's Joint European Torus (JET) Project. Successful solutions are applied where possible and, in many cases, improved in order to achieve the performance demanded by a multiyear program that must be capable of efficiently executing RM procedures. Early, concurrent efforts in the design and fabrication of prototype remote handling (RH) equipment, remote tooling, and maintainable machine components will precede an extensive use of mock-up equipment in order to test, develop, and demonstrate the technology. 7 refs,. 5 figs.

**35422** (CONF-910968–10) **Scoping studies for small steady-state tokamaks for divertor testing.** Galambos, J.D.; Peng, Y.K.M.; Nelson, B.E.; Hirshman, S.P.; Fogarty, P.J. Oak Ridge National Lab., TN (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000740. Source: OSTI; NTIS; INIS; GPO Dep.

A prime uncertainty in next-generation devices is the divertor performance. For the International Thermonuclear Experimental Reactor (ITER), the divertor limit often plays a more critical role in the operational scenario definition than do beta limit and energy confinement constraints. Hence, it is desirable to test the divertors in an environment as close as possible to that expected in next-step burning plasma experiments. Initial global scoping studies are done for small, steady-state, copper coil, beam-driven tokamaks that are dedicated to divertor testing. The usual ITER global physics models (beta limit, energy confinement, and analytic divertor heat load calculation) are incorporated, and for performance criteria we require that the divertor heat load and plasma collisionality in the edge region be similar to those expected in ITER. The smallest, lowest-cost devices satisfying these constraints tend to have major radius below 1 m, plasma current of 0.5 to 1 MA, and low aspect ratio and costs of a few tens of millions of dollars. Injection powers of about 4 to 5 MW are needed to sustain the plasma current, maintain plasma power balance, and provide the required divertor heat load. 6 refs., 5 tabs.

**35423** (CONF-910968–11) **ITER physics design guidelines at high aspect ratio.** Uckan, N.A. Oak Ridge National Lab., TN (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000729. Source: OSTI; NTIS; INIS; GPO Dep.

The physics requirements for ITER design are formulated in a set of physics design guidelines. These guidelines, established by the ITER Physics Group during the Conceptual Design Activity (CDA, 1988–90), were based on credible extrapolations of the tokamak physics database as assessed during the CDA, and defined a class of tokamak designs (with plasma current I ~20 MA and aspect ratio A ~2.5–3.5) that meet the ITER objectives. Recent US studies have indicated that there may be significant benefits if the ITER-CDA design point is moved from the low aspect ratio, high current baseline (A = 2.79, I = 22 MA) to a high aspect ratio machine at A ~4, I ~15 MA, especially regarding steady-state, technology-testing performance. To adequately assess the physics and technology testing capability of higher aspect ratio design options, several changes are proposed to the original ITER guidelines to reflect the latest (although limited) developments in physics understanding at higher aspect ratios. The critical issues for higher aspect ratio design options are the uncertainty in scaling of confinement with aspect ratio, the variation of vertical stability with elongation and aspect ratio, plasma shaping requirements, ability to control and maintain plasma current and q-profiles for MHD stability (and volt-second consumption), access for current

drive, restrictions on field ripple and divertor plate incident angles, etc. 5 refs., 1 tab.

**35424** (CONF-910968–12) **Mechanical design issues associated with mounting, maintenance, and handling of an ITER divertor.** Goranson, P.L.; Fogarty, P.J.; Jones, G.H. Oak Ridge National Lab., TN (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000742. Source: OSTI; NTIS; INIS; GPO Dep.

Several designs that address plasma-facing plate configurations and thermal-hydraulic design issues have been developed for the ITER divertor. Design criteria growing out of physics requirements, physical constraints, and remote handling requirements impose severe mechanical requirements on the support structure and its attachments. These pose a challenge to the mechanical design of a divertor, which must be addressed before a functional divertor is practical – that is, one that can be remotely handled, aligned, and maintained; that functions reliably under thermal loading and disruptions; and that gives the required life in the nuclear environment predicted for ITER. This paper discusses the design criteria for the divertor mounting structure and identifies the mechanical design issues that need to be addressed. Achieving the criteria may require the development of new components and innovative configurations, specifically a new class of remote fasteners and electrically resistant material for mounts. The possible design of such components and an R&D program to develop them are described, and issues specific to the high-aspect-ratio design (HARD) configuration are summarized. Analysis and experiments that will resolve these issues and concerns and lead to a final ITER design are identified. 2 refs., 2 figs.

**35425** (CONF-910968–13) **Plasma shape control calculations for BPX divertor design.** Strickler, D.J. (Oak Ridge National Lab., TN (United States)); Neilson, G.H.; Jardin, S.C.; Pomphrey, N. Oak Ridge National Lab., TN (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000731. Source: OSTI; NTIS; INIS; GPO Dep.

The Burning Plasma Experiment (BPX) divertor is to be capable of withstanding heat loads corresponding to ignited operation and 500 MW of fusion power for a current rise time and flattop lasting several seconds. The poloidal field (PF), diagnostic, and feedback equilibrium control systems must provide precise X-point position control in order to sweep the separatrices across the divertor target surface and optimally distribute the heat loads. A control matrix MHD equilibrium code, BEQ, and the Tokamak Simulation Code (TSC) are used to compute preprogrammed double-null (DN) divertor sweep trajectories that maximize sweep distance while simultaneously satisfying a set of strict constraints: minimum lengths of the field lines between the X-point and strike points, minimum spacing between the inboard plasma edge and the limiter, maximum spacing between the outboard plasma edge and the ICRF antennas, minimum safety factor, and linked poloidal flux. A sequence of DN diverted equilibria and a consistent TSC fiducial discharge simulation are used in evaluating the performance of the BPX divertor shape and possible modifications. 5 refs., 10 figs.

**35426** (CONF-910968–14) **Electromagnetic loads on ITER in-vessel components.** Williamson, D.E.; Conner, D.L.; Nelson, B.E.; Sayer, R.O.; Yugo, J.J. Oak Ridge National Lab., TN (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000672. Source: OSTI; NTIS; INIS; GPO Dep.

Design of the vacuum vessel and internal blanket/shield modules for the International Thermonuclear Experimental Reactor (ITER) is strongly influenced by the magnitude of electromagnetic loads due to plasma disruption. Calculations with the finite element code, EddyCuFF, have been performed to quantify these loads and incorporate them into the design process. A multifilament model of plasma motion and current decay has been developed using data generated by the Tokamak Simulation Code (TSC). Comparison with calculations employing single filament plasma models illustrates the need to use self-consistent, distributed plasma scenarios when analyzing toroidally segmented components. Application is made to design and analysis of the high aspect ratio design (HARD) option vessel and blanket/shield modules. Variations in geometry, response characteristics, and electromagnetic loads are compared to the reference design values. 5 refs., 8 figs., 4 tabs.

**35427** (CONF-910968–15) **Stress analysis of a double-wall vacuum vessel for ITER.** Conner, D.L.; Williamson, D.E.; Nelson, B.E. Oak Ridge National Lab., TN (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000681. Source: OSTI; NTIS; INIS; GPO Dep.

The preliminary structural analyses performed in support of the design of the vacuum vessel for the International Thermonuclear Experimental Reactor (ITER) are described. A thin, double-wall, all-welded structure is the proposed design concept analyzed. The results of the static stress analysis indicate the adequacy of such a structure. The effects of the proposed high-aspect-ratio design configuration on loading and stresses are also discussed. 4 refs., 6 figs., 1 tab.

**35428** (CONF-910968–16) **The effect of the high-aspect-ratio design parameters on ITER containment structures.** Nelson, B.E.; Conner, D.L.; Fogarty, P.J.; Jones, G.H.; Lousteau, D.C.; Williamson, D.E. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000736. Source: OSTI; NTIS; INIS; GPO Dep.

The containment structures for the International Thermonuclear Experimental Reactor (ITER) include the plasma vacuum vessel, the structural supports for the in-vessel components, the gravity supports for the vacuum vessel and magnet system, the passive stabilizing structure, the internal fast active coils, and the cryostat vacuum vessel. Reference design concepts for all of these components have been prepared as part of the ITER Conceptual Design Activity (CDA), for the standard ITER design point: Aspect ratio of 2.8, major radius of 6 m, central toroidal field of 4.8 T, and peak plasma current of 22 MA. A proposal has been made to improve the performance of ITER by modifying the reference design point. The high-aspect-ratio design (HARD) proposal increases the aspect ratio to 4, increases the central toroidal field to 7 T, and decreases the peak plasma current to 14.8 MA. Systems studies indicate that the HARD parameters provide improved technology testing capability by increasing the neutron wall loading while maintaining the CDA physics constraints (beta limit, energy confinement, etc.). Changes in configuration, loading, stresses, and other factors for the containment structures components, based on the HARD parameters, have been investigated. The effects of these changes, both positive and negative, are discussed. The primary considerations are: Does the HARD design meet all of the functional requirements? Does the HARD design resolve and/or reduce any of the technical problems inherent in the CDA design? Does the HARD design create and/or exacerbate any technical problems? Are cost savings associated with the HARD configuration?

**35429** (CONF-910968–17) **Design of a tritium pellet injector for TFTR.** Milora, S.L. (Oak Ridge National Lab., TN (United States)); Gouge, M.J.; Fisher, P.W.; Combs, S.K.; Cole, M.J.; Wysor, R.B.; Fehling, D.T.; Foust, C.R.; Baylor, L.R.; Schmidt, G.L.; Barnes, G.W.; Persing, R.G. Oak Ridge National Lab., TN (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000737. Source: OSTI; NTIS; INIS; GPO Dep.

The TFTR tritium pellet injector (TPI) is designed to provide a tritium pellet fueling capability with pellet speeds in the 1– to 3 km/s-range for the TFTR D-T phase. The existing TFTR deuterium pellet injector is being modified at Oak Ridge National Laboratory to provide a fourshot, tritium-compatible, pipe-gun configuration with three upgraded single-stage pneumatic guns a two -stage light

gas gun driver. The pipe gun concept has been qualified for tritium operation by the tritium proof-of-principle injector experiments conducted on the Tritium Systems Test Assembly at Los Alamos National Laboratory. In these experiments, tritium and D-T pellets were accelerated to speeds near 1.5 km/s. The TPI is being designed for pellet sizes in the range from 3.43 to 4.0 mm in diameter in arbitrarily programmable firing sequences at speeds up to approximately 1.5 km/s for the three single-stage drivers and 2.5 to 3 km/s for the two-stage driver. Injector operation will be controlled by a programmable logic controller. 7 refs., 4 figs.

**35430** (CONF-910968–18) **BPX insulation irradiation program test results.** McManamy, T.J. (Oak Ridge National Lab., TN (United States)); Kanemoto, G.; Snook, P.G. Oak Ridge National Lab., TN (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92000739. Source: OSTI; NTIS; INIS; GPO Dep.

The toroidal field coil insulation for the Burning Plasma Experiment (BPX) is expected to receive a radiation dose of nearly $10^{10}$ rad and to withstand significant mechanical stresses. An irradiation test program was performed at the Idaho National Engineering Laboratory (INEL) using the Advanced Technology Reactor (ATR) for irradiations to doses on the order of $3 \times 10^{10}$ rad. The flexure and shear strength with compression of commercially procured sheet material were reported earlier. A second series of tests has been performed to slightly higher dose levels with vacuum impregnated materials, glass strand material, and Spaulrad-S sheet samples. Vacuum impregnation with a Shell 9405 resin and 9470 hardener was used to produce bonded copper squares and flexure samples of both pure resin and resin with S-glass. A new test fixture was developed to test the bonded samples in shear without applied compression. The Spaulrad-S flexure samples demonstrated a loss of strength with irradiation, similar to previous results. The pure resin lost nearly all flexibility, while the S-glass-reinforced samples retained between 30% and 40% of the initial flexure strength. The S-glass strands showed a 30% loss of strength at the higher dose level when tested in tension. The bonded copper squares had a low room-temperature shear strength of approximately 17 MPa before irradiation, which was unchanged in the irradiated samples. Shear testing of unirradiated bonded copper squares with ten different types of surface treatment revealed that the low shear strength resulted from the polyurethane primer used. In the later series of test, the epoxy-based primers and DZ-80 from Ciba-Geigy did much better, with shear strengths on the order of 40 MPa. These samples also demonstrated a resistance to cryogenic shock. One irradiated bonded sample was tested up 10 210 MPa in compression, the limit of the test fixture, without failure.

**35431** (CONF-910968–19) **Heating profiles on ICRF antenna Faraday shields.** Taylor, D.J.; Baity, F.W.; Hahs, C.L.; Riemer, B.W.; Ryan, P.M.; Williamson, D.E. Oak Ridge National Lab., TN (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991. Order Number DE92001679. Source: OSTI; NTIS; INIS; GPO Dep.

A conceptual design for an uncooled Faraday shield for the BPX ion cyclotron resonance heating (ICRH) antenna, which should withstand the proposed long-pulse operation, has been completed. A high-heat-flux, uncooled Faraday shield has also been designed for the fast-wave current drive (FWCD) antenna on D3-D. For both components, the improved understanding of the heating profiles made it possible to design for heat fluxes that would otherwise have been too close to mechanically established limits. The analytical effort is described in detail, with emphasis on the design work for the BPX ICRH antenna conceptual design and for the replacement Faraday shield for the D3-D FWCD antenna. Results of analyses are shown, and configuration issues involved in component modeling are discussed. 3 refs., 6 figs., 2 tabs.

**35432** (CONF-9110231–1) **Potential improvements to ENDF/B-VI for fusion data.** Larson, D.C.; Fu, C.Y. Oak Ridge National Lab., TN (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Topical conference on nuclear data for fusion reactor technology; Karlsruhe (Germany); 23 Oct 1991. Order Number DE92000435. Source: OSTI; NTIS; INIS; GPO Dep.

While ENDF/B-6 is significant improvement over previous versions for fusion reactor design calculations, several areas have not received attention and may need improvement. In addition, broadening of the contents of the evaluations to contain information not easily derived at present should be considered. 11 refs.

**35433** (CONF-911111–2) **Anisotropic dislocation loop nucleation in ion-irradiated $MgAl_2O_4$.** Zinkle, S.J. Oak Ridge National Lab., TN (United States). [1991]. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From International conference on fusion reactor materials; Clearwater, FL (United States); 17-22 Nov 1991. Order Number DE92001681. Source: OSTI; NTIS; INIS; GPO Dep.

Polycrystalline disks of stoichiometric magnesium aluminate spinel ($MgAl_2O_4$) were irradiated with 2 MeV $Al^+$ ions at 650°C and subsequently analyzed in cross-section using transmission electron microscopy (TEM). Interstitial dislocation loops were observed on 110 and 11 habit planes. The population of loops on both sets of habit planes was strongly dependent on their orientation with respect to the ion beam direction. The density of loops with habit plane normals nearly perpendicular to the ion beam direction much higher than loops with habit plane normals nearly parallel to the ion beam direction. On the other hand, the loop size was nearly independent of habit plane orientation. This anisotropic loop nucleation does not occur in ion-irradiated metals such as copper. An additional anomaly associated with ion-irradiated spinel is that the loops on 111 planes were partially unfaulted with a Burgers vector of $b = a/4\langle 110 \rangle$. Previous neutron irradiation studies have never reported unfaulted loops in stoichiometric spinel. Possible cause of the unusual response of spinel to ion irradiation are discussed. 12 refs., 14 figs.

**35434** (CONF-911240–1) **Recent progress in the development of materials for fusion reactors.** Bloom, E.E.; Rowcliffe, A.F. Oak Ridge National Lab., TN (United States). [1991]. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From 2. Japan international Society for the Advancement of Material and Process Engineering (SAMPE) symposium and exhibition; Chiba (Japan); 11-14 Dec 1991. Order Number DE91016283. Source: OSTI; NTIS; INIS; GPO Dep.

Development of materials with suitable properties is essential if fusion is to be realized as an economic, safe, and environmentally acceptable energy source. For each of the major reactor systems (e.g., superconducting magnets, blankets, divertors, auxiliary heating, and diagnostic devices), material requirements have been defined and alloy and ceramic systems, which have attractive properties for the various applications, have been identified. The next experimental fusion reactor, the International Thermonuclear Experimental Reactor (ITER), will utilize existing materials technology. However, for many applications in power reactors, existing materials do not have adequate properties and advanced materials must be developed. This paper presents an overview of the status of materials technology in four key areas: structural materials for the first wall and blanket (FWB), plasma-facing materials, materials for superconducting magnets, and ceramics for electrical and structural applications. 7 refs.

**35435** (DOE/DP/40200–166) **LLE review quarterly report, April–June 1991: Volume 47.** Jaanimagi, P.A. (ed.). Rochester Univ., NY (United States). Lab. for Laser Energetics. [1991]. 72p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FC03-85DP40200. Order Number DE91018828. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This volume of the LLE Review, covering the period April–June 1991, contains articles on the production and characterization of hot, long-scale-length laser plasmas, a new x-ray spectroscopic method for diagnosing laser-driven target implosions, and two-dimensional (2-D) simulation results that confirm the dominance of kinetic thermal filamentation over ponderomotive filamentation. The section on advanced technology includes a report on the time-domain characterization of bent coplanar waveguides, and a study of the surface disordering of Pb(100) at temperatures below the bulk-melting temperature. Finally, the activities of the National

Laser Users Facility and the GDL and OMEGA laser facilities are summarized.

**35436** (DOE/ER/52122–6) **High-power microwave transmission systems for electron-cyclotron-resonance plasma heating: Progress report, September 1, 1990–August 31, 1991.** Vernon, R.J. Wisconsin Univ., Madison, WI (United States). Dept. of Electrical and Computer Engineering. Aug 1991. 49p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER52122. Order Number DE92000020. Source: OSTI; NTIS; INIS; GPO Dep.

This progress report is for the sixth year of a grant from the US Department of Energy for the design, development, and fabrication of ECRH transmission and mode conversion systems to transport microwave power from a gyrotron to a magnetically confined plasma. The design and low-power testing of new and improved components for such systems and development of underlying theory is the focus of this project. Devising and improving component testing and diagnostic techniques is also an important part of this effort. The development of possible designs for sections of gyrotrons themselves, such as tapers or Vlasov-type launchers, in support of the Varian gyrotron development program is also considered when appropriate. We also provide support to other groups working on ECR heating of magnetically confined plasmas such as the groups at General Atomics, the University of Texas at Austin, and Lawrence Livermore National Laboratory. During the last year, we designed and had fabricated a two-dimensional Vlasov antenna system for a 110 GHz $TE_{15,2}$ mode gyrotron for possible use at General Atomics. The system included the launcher section, a visor, main reflector, and focusing reflector. Programs to generate the tool-path profiles to cut the "General Atomics" Vlasov components on a milling machine were developed. We have also developed state-of-the art theory and programs for three-dimensional whispering-gallery-mode Vlasov antenna systems. A design for a 110 GHz $TE_{01}$-$TE_{15,2}$ mode converter system for cold testing WGM Vlasov antenna systems was developed and is currently being fabricated also.

**35437** (DOE/ER/52127–81) **CTR plasma engineering studies: Annual progress report, 1 December 1990–30 November 1991.** Miley, G.H. Illinois Univ., Urbana, IL (United States). Fusion Studies Lab. [1991]. 97p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-86ER52127. Order Number DE92000761. Source: OSTI; NTIS; INIS; GPO Dep.

Ash (e.g. thermalized helium from D-T) buildup in a tokamak can potentially prevent ignition and seriously degrade the fusion energy gain from driven system. This problem is most pronounced as the ratio of particle/energy confinement time increases towards the neoclassical limit. Yet much improved confinement of the fuel ions is desirable for a fusion reactor. The goals of the work described here were two fold: to study the effect of helium buildup on the energy balance for a tokamak, and consider methods of active control that might be employed to alleviate the problem. We examine ash buildup effect for both D-T and D-$^3$He systems. Most examples used apply to the ARIES 1 D-T reactor design and to the ARIES 3 D-$^3$He design since part of this was in support of these two designs. Then we report on brief studies of two potentially attractive control methods, namely controlled sawtooth and fishbone instabilities. The concept is that sawteeth or fishbones would be used on purpose periodically in order to "flush" out excess ash from the fusion core. Both methods are shown to feasible and attractive. More study is needed, however, since the phenomenona in which are physically complex. Still the pay off, namely, reduced ash buildup, is exceedingly important so that such studies desires strong attention.

**35438** (EGG-FSP–9789) **Trapping effects on diffusion transients.** Longhurst, G.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). Jul 1991. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018717. Source: OSTI; NTIS; INIS; GPO Dep.

Trapping in a material subject to a diffusion-driven permeation transient can cause a substantial alteration of the shape and time scale of the transient. This happens because the filling and subsequent emptying of the trap sites causes a perceptible delay in movement of the diffusing species through the material. By studying the shape and temperature sensitivity of permeation transients, it is possible to learn something about the nature of the traps. In this report I have undertaken to show the relationship of the permeation transients under various assumptions about the traps to those when no trapping is operative. One limit assumes that traps are only partially filled. In that case the transient has all the characteristics of a classical nontrapping permeation transient, but the time constant is extended by a quantity that depends on material properties and temperature along. In another limit, all the traps are assumed to be filled locally before diffusion takes the solute past the region of trap filling. In that case the transient is governed by geometric effects. Other cases will be intermediate to these two limits. I have defined a trapping parameter that characterizes the effect of traps on the apparent diffusion time constant and a discriminant that indicates which limit should dominate. 1 ref., 3 figs.

**35439** (ENEA-RTI-INN–91-04) **ANABASI code for thermo-mechanical behaviour of BIT breeder pellet.** Cosoli, G. ENEA, Casaccia (Italy). Area Energia e Innovazione. 1991. 35p. (In Italian). (RTI-INN–91-04). Order Number DE92705889. Source: OSTI; NTIS (US Sales Only).

Originally written to define the in-pile behaviour of a fission bar, the ANABASI code was modified to reflect the construction and performance characteristics of a BIT breeder pellet - 316 L steel sheath containing gamma-Li - aluminium oxide. The principle modifications regarded the code's ability to characterize the pellet's structural materials and calculate the deformations and stresses induced by a temperature gradient. The routines for the execution of the iterative calculations remained essentially unchanged with respect to the fission version of the code. In its present form, the code does not take into consideration time dependent phenomena for which case a 'life start' behavioural model is necessary. In its general application, the mechanical model can be applied to elastic regime calculations of deformations and stresses generated within any finite-height cylinder by a temperature gradient.

**35440** (GA-A–20624) **A system to deposit boron films (boronization) in the DIII-D tokamak.** Hodapp, T.R. (General Atomics, San Diego, CA (United States)); Jackson, G.L.; Phillips, J.; Holtrop, K.L.; Petersen, P.I.; Winter, J. General Atomics, San Diego, CA (United States). Sep 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-910968–6: 14. IEEE symposium on fusion engineering, San Diego, CA (United States), 30 Sep - 3 oct 1991). Order Number DE92000288. Source: OSTI; NTIS; INIS; GPO Dep.

A system has been added to the D3-D tokamak to coat its plasma facing surfaces with a film of boron using diborane gas. The system includes special health and safety equipment for handling the diborane gas which is toxic and inflammable. The purpose of the boron film is to reduce the levels of impurity atoms in the D3-D plasmas. Experiments following the application of the boron film in D3-D have led to significant reductions in plasma impurity levels and the observation of a new, very high confinement regime. 9 refs., 1 fig.

**35441** (GA-A–20627) **110 GHz ECH heating system for DIII-D.** Callis, R.; Cary, W.; Moeller, C.; Freeman, R.; Prater, R.; Remsen, D.; Sevier, L. General Atomics, San Diego, CA (United States). Aug 1991. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-89ER51114. (CONF-910869–6: 9. topical conference on radio frequency power in plasmas, Charleston, SC (United States), 12-14 Aug 1991). Order Number DE91018732. Source: OSTI; NTIS; INIS; GPO Dep.

Electron cyclotron heating (ECH) has been demonstrated to be effective at heating tokamak plasmas in DIII-D and other tokamaks. Extension of these results to high frequency and higher power in DIII-D is planned using 110 GHz outside launch X-mode at the second harmonic. A 2 MW system constructed from four modules, each using a Varian 0.5 MW 110 GHz gyrotron, is scheduled to be completed by May 1992; construction of a complete 0.5 MW module is complete and is in checkout. The results of the engineering test will be reported. A unique feature of this design is the use of strongly guided $HE_{11}$ modes to transmit the power over the long distances required. The choice of a strongly guided $HE_{11}$ mode for

transmitting the ECH power was influenced by the compact waveguide, the non-critical alignment which allows waveguide flex, the ability to use mode selective directional couplers, and finally, continuous curvature bends can be used since there are no trapped modes. The waveguide is evacuated to handle the required power density. Implementation of this design required the development of mode converters to convert from the $TE_{15,2}$ mode generated by the gyrotron to the desired $HE_{11}$. Results of the high power tests of the mode converters and transmission components will be presented. 2 refs., 1 fig.

**35442** (HMI-B–467) **Interactions of hydrogen with graphite at low pressure and elevated temperature.** Hoinkis, E. Hahn-Meitner-Institut Berlin GmbH (Germany). Mar 1991. 76p. Order Number DE92714326. Source: OSTI; NTIS (US Sales Only); INIS.

The plasma facing components of the vacuum chamber for thermonuclear fusion experiments are clad with graphite. Recycling of gases affects the plasma properties, and the tritium quantity accumulated in the graphite during the operation of Tokamaks with DT must be known. An adsorption isotherm for deuterium on the nuclear grade graphitic Matrix A3-3 was measured by using a volumetric method at 1173 K at pressures < 130 Pa. The data obey a Langmuir type isotherm for dissociative adsorption. The saturation concentration is 140 appm. The adsorption energy at 0 K was estimated as $E_c$ = 2.5 eV/$D_2$ using Fowler's equation and isotherms were calculated for this $E_c$ value. These isotherms predict saturation of the adsorption sites in graphite at T < 700 K and $P_{D2} > 0.1$ Pa. At T > 1173 K and $P_{D2} < 10^{-2}$ Pa the adsorbed quantity is less than 1% of the saturation level. The release kinetics of deuterium was measured at temperatures uo to 2000 K. $D_2$ desorption commenced at 1170 K. The maximum of the release rate is observed at $T_p$ = 1770 K. A Lennard-Jones potential energy diagram was calculated, which suggests a C-H bond energy $E_b \simeq 3.4$ eV/D and an activation energy of desorption $E_d \simeq 4$ eV/$D_2$. The partial pressures of hydrocarbons $C_n$ $_{\leq 3}$ $H_m$ in equilibrium with graphite were calculated. At total pressures < $10^{-2}$ Pa the partial pressures of these hydrocarbons are less than $10^{-7}$ Pa in the temperature range 600-1500 K. (orig./MM).

**35443** (IAEA-TECDOC–572, pp. 53-64) **"Low-activation" fusion materials development and related nuclear data needs.** Cierjacks, S. (KfK-Euratom Association, Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung). International Atomic Energy Agency, Vienna (Austria). Oct 1990. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

So-called "low-activation" materials are presently considered as an important means of improving the safety characteristics of future DT fusion reactors. Essential benefits are expected in various problem areas ranging from operation considerations to aspects of decommissioning and waste disposal. Present programs on "low-activation" materials development depend strongly on reliable activity calculations for a wide range of technologically important materials. The related nuclear data requirements and important needs for more and improved nuclear data are discussed. (author). 32 refs, 4 figs, 4 tabs.

**35444** (IAEA-TECDOC–572, pp. 45-52) **Measurement of long-lived isotopes and helium production in fusion materials.** Greenwood, L.R. (Argonne National Lab., IL (USA)). International Atomic Energy Agency, Vienna (Austria). Oct 1990. Contract W-31-109-Eng-38. (CONF-8909234–: Advisory group meeting on nuclear data for radiation damage assessment and related safety aspects, Vienna (Austria), 19-22 Sep 1989). In *Nuclear data for radiation damage assessment and related safety aspects 1989: Proceedings of an advisory group meeting held in Vienna, 19-22 September 1989.* 193p. Order Number DE92601383. Source: OSTI; NTIS (US Sales Only); INIS.

Results are summarized for measurements of the production rates for long-lived radioisotopes and helium in fusion reactor materials. Measurements have been performed at T(d,n) generators, near 14 MeV; at broad-spectrum Be(d,n) accelerator-based neutron fields; and in various fission reactors. These activation data are used to predict the production of these isotopes in fusion reactor materials for waste disposal and maintenance applications. Helium data are needed for the simulation of fusion materials damage in fission reactor irradiations and as a stable product dosimeter. Nuclear data needs and future plans are discussed. (author). 20 refs, 5 figs, 4 tabs.

**35445** (IPP–1/260) **ASDEX-upgrade poloidal field coils. Specifications, load, stress. Pt. 1.** Pillsticker, M.; Werner, F. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Apr 1991. 118p. (In German). Order Number DE92714328. Source: OSTI; NTIS (US Sales Only); INIS.

The pulsed and irregular load of the ASDEX-Upgrade poloidal field coils postulates a careful analysis of the maximum stresses in order to find out the criteria for specifications and supervision. For operating conditions known at the time of coil design, maximum stresses and loads are compiled and the resulting features and limitations of coil operation are explained. (orig.).

**35446** (IPP–5/40) **An ablation rate model for time-dependent pellet ablation studies at Max-Planck-Institute.** Parks, P.B. (General Atomics Co., San Diego, CA (USA)). Max-Planck-Institut fuer Plasmaphysik, Garching (Germany). Jun 1991. 17p. Order Number DE92714338. Source: OSTI; NTIS (US Sales Only); INIS.

The ablation cloud of a pellet injected into a plasma consists of two fairly distinct regions: (1) a cold, dense, weakly ionized core region, whose expansion is spherically symmetric and (2) a warm plasma outer region which forms an elongated channel parallel to B vector. The core region is transonic; The pellet mass ablation rate depends only on the attenuation by the total $\int$ ndl in the outer region. The quasi-steady 'fast' core region provides a particle source for the more slowly evolving outer region, described using a time-dependent model under development at IPP-Garching. By joining the two regions a self-consistent ablation model can be constructed for refuelling studies on fusion grade plasmas. (orig.).

**35447** (JAERI-M–91-048) **Study on particle transport to wall in JFT-2M edge plasma by accelerator-based analysis.** Nakajima, Tadashi (Kobe Univ. of Mercantile Marine (Japan)); Takaya, Izumi; Akiyama, Takeshi; Kitamura, Akira; Yano, Syukuro; Sengoku, Seio; Ohtsuka, Hideo; Maeda, Hikosuke. Japan Atomic Energy Research Inst., Tokyo (Japan). Mar 1991. 67p. (In Japanese). Order Number DE92704084. Source: OSTI; NTIS (US Sales Only); INIS.

Transport of hydrogen-isotope particles, D and H, in the scrape-off layer (SOL) of JFT-2M having S.S.304 wall (partially covered with carbon ~ 40%) was studied using an accelerator-based collector probe method. Here irradiation conditions were provided with the Taylor discharge cleaning (TDC) and the ohmically heated discharge (OHD) with or without neutral beam injection (NBI). First, effects of the wall on TDC-particle transport were examined with Si probes in the D-OHD after the $D_2$-(or $H_2$-)TDC; some of the D(or H) particles absorbed in the wall in the preceding $D_2$-(or $H_2$-)TDC are recycled in the subsequent OHD to reach the plasma boundary through the SOL. This effect was also confirmed in another experiment; in the $H_2$-TDC followed by the D-OHD the H/D fluence ratio distribution is found to increase toward the wall, indicating that some of the H particles due to the $H_2$-TDC are recycled from the wall to join the SOL plasma. Next, we measured the effect of high-fluence $H_2$-TDC particles on the H retention of two C probes (C: Type AX-650K of Toyo Carbon Co., which is the same as JFT-2M divertor-plate material). In spite of the same H fluence (~6 x $10^{20}$ $cm^{-2}$) the retention of a sample having the smooth surface reached a saturated level of 5.44 x $10^{17}$ $cm^{-2}$ while that of the other sample having the rough surface (as made) was in an unsaturated region (1.6 x $10^{17}$ $cm^{-2}$), suggesting an importance of the surface condition. Finally, it becomes evident from the C-probe experiment in the $D_2$->$H_2$ (or $H_2$->$D_2$) TDC that some of the D(or H) particles absorbed in C during the preceding $D_2$-(or $H_2$-) TDC are replaced

'partially' by the H(or D) particles entering during the subsequent $H_2$-(or $D_2$-) TDC even under the 'unsaturated' condition. (J.P.N.).

**35448** (JAERI-M–91-080) **Japanese contributions to containment structure, assembly and maintenance and reactor building for ITER.** Shibanuma, Kiyoshi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Honda, Tsutomu; Kanamori, Naokazu. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 367p. Order Number DE92704286. Source: OSTI; NTIS (US Sales Only); INIS.

Joint design work on Conceptual Design Activity of International Thermonuclear Experimental Reactor (ITER) with four parties, Japan, the United States, the Soviet Union and the European Community began in April 1988 and was successfully completed in December 1990. In Japan, the home team was established in wide range of collaboration between JAERI and national institute, universities and heavy industries. The Fusion Experimental Reactor (FER) Team at JAERI is assigned as a core of the Japanese home team to support the joint Team activity and mainly conducted the design and R and D in the area of containment structure, remote handling and plant system. This report mainly describes the Japanese contribution on the ITER containment structure, remote handling and reactor building design. Main areas of contributions are vacuum vessel, attaching locks, electromagnetic analysis, cryostat, port and service line layout for containment structure, in-vessel handling equipment design and analysis, blanket handling equipment design and related short term R and D for assembly and maintenance, and finally reactor building design and analysis based on the equipment and service line layout and components flow during assembly and maintenance. (author).

**35449** (JAERI-M–91-081) **Concept study of the Steady State Tokamak Reactor (SSTR).** Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 632p. Order Number DE92713919. Source: OSTI; NTIS (US Sales Only); INIS.

The Steady State Tokamak Reactor (SSTR) concept has been proposed as a realistic fusion power reactor to be built in the near future. An overall concept of SSTR is introduced which is based on a small extension of the present day physics and technologies. The major feature of SSTR is the maximum utilization of a bootstrap current in order to reduce the power required for the steady state operation. This requirement leads to the choice of moderate current (12 MA), and high $\beta p$ (2.0) for the device, which are achieved by selecting high aspect ratio (A=4) and high toroidal magnetic field (16.5 T). A negative-ion-based neutral beam injection system is used both for heating and central current drive. Notable engineering features of SSTR are: the use of a uniform vacuum vessel and periodical replacements of the first wall and blanket layers and significant reduction of the electromagnetic force with the use of functionally gradient material. It is shown that a tokamak machine comparable to ITER in size can become a power reactor capable of generating about 1 GW of electricity with a plant efficiency of $\approx$30%. (author).

**35450** (JAERI-M–91-089) **Conceptual design and technology development of containment structure in Fusion Experimental Reactor (FER).** Nishio, Satoshi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Sato, Keisuke; Matsuoka, Fushiki; Kanamori, Naokazu; Koizumi, Koichi; Abe, Tetsuya; Hosobuchi, Hideo; Tada, Eisuke; Yamada, Masao. Japan Atomic Energy Research Inst., Tokyo (Japan). May 1991. 145p. (In Japanese). Order Number DE92704100. Source: OSTI; NTIS (US Sales Only); INIS.

A conceptual design of FER (Fusion Experimental Reactor) containment structure and its associated R and D activities, conducted from '89 to '90, are described. The FER containment structure system which mainly consists of a vacuum vessel, shielding structures, in-vessel replaceable components, ports, a cooling pipe system, has been developed to fullfil the required function. As an initial stage of R and D activities, the elemental technologies common to a tokamak reactor have been developed. Among them, a locking mechanism for supporting in-vessel replaceable components and a technique for insulation/conduction are described. For the locking mechanism, a caulking cotter driven by hydraulic pressure has been employed. Three kinds of hydraulic driving mechanism have been manufactured by trial: a 'piston jack' type, a 'bellows' type and a 'flexible tube' type. In the latter type, the stroke is obtained by changing the cross section of the flexible tube from a flat racetrack shape to a fat shape by hydraulic pressure. As the result of preliminary performance test, the shape of 'flexible tube' has been found to be improved. For the insulation coating, $Al_2O_3$ has been selected as the material and a plasma spray method has been applied as the coating procedure. For the conduction coating, $Cr_3C_2$ has been selected as the material and JET-KOTE method has been applied as the coating procedure. Both methods have been successfully developed and have been confirmed to be applicable the actual machine. A one fifth scale model has been fabricated in order to verify the design feasibility, mainly geometrical consistency. Then some design modifications were found to be needed for some of the components based on the manufacturing experience. (author).

**35451** (JAERI-M–91-109) **Revised graphs of activation data for fusion reactor applications.** Seki, Yasushi (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Kawasaki, Hiromitsu; Yamamuro, Nobuhiro; Iijima, Shungo. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 317p. Order Number DE92704288. Source: OSTI; NTIS (US Sales Only); INIS.

Activation data are required for calculation of induced activity in a fusion reactor. This report gives in graphical form, the activation data which have been evaluated based on recent measurements and calculations, for use in the activation calculation code system THIDA-2. It shows transmutation and decay chain data, activation cross sections and decay gamma-ray emission data for 152 nuclides of interest in terms of fusion reactor design. This report is an updated and enlarged version of a similar report compiled in 1982 for the activation data of 116 nuclides, which had been shown to be extremely effective in referring the activation data and in locating and correcting inappropriate data. (author).

**35452** (KEK–90-15, pp. 277-287) **Application of spin-polarized fuel to fusion reactions.** Wakuta, Y. (Kyushu Univ., Fukuoka (Japan). Faculty of Engineering); Nakao, Y.; Honda, T.; Honda, Y.; Nakashima, H. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Nov 1990. (CONF-900289–: RCNP cyclotron cascade workshop on polarized ion sources and gas jets for nuclear physics at an intermediate energy, Tsukuba-Shi (Japan), 12-17 Feb 1990). In *Proceedings of the international workshop on polarized ion sources and polarized gas jets.* 393p. Order Number DE91780384. Source: OSTI; NTIS (US Sales Only); INIS.

Studies on the application of the polarized fuel to the inertial fusion reaction have been carried out. It is shown that the use of the spin-polarized fuel D vectorcenter dotT vector or D vectorcenter dot$^3$(He)vector reduces the irradiating laser power more than 50% compared with the use of the unpolarized fuel. The depolarization rate of the polarized fuel during the fusing process is found to be almost negligible. (author).

**35453** (LA-UR–91-2876) **Richtmyer-Meshkov instability of shocked gaseous interfaces.** Benjamin, R.F. (Los Alamos National Lab., NM (United States)); Besnard, D.; Haas, J.F. Los Alamos National Lab., NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9107138–3: 18. international symposium on shock waves, Sendai (Japan), 21-26 Jul 1991). Order Number DE92000308. Source: OSTI; NTIS; GPO Dep.

The instability of shocked and reshocked perturbed interface between gases of different densities is analyzed by comparing flow visualization from 2D and 3D shock-tube experiments with 2D numerical simulations and theory. The shadowgraphs and calculations show similar large scales of mixing by fluid interpenetration induced by the Richtmyer-Meshkhov instability. In 2D, experimental instability growth following acceleration by the initial shock is less than calculated by linear theory or simulated. The 3D experiments are approximately simulated by 2D calculations with an increased initial amplitude of the interface. The kinetic energy of the interpenetrating velocity field from the simulations are also compared to a theoretical estimate derived from the linear theory. 2 refs., 10 figs.

**35454** (LA-UR–91-3017) **Tritium retention in jet cryopanel samples.** Walthers, C.R. (Los Alamos National Lab., NM (United

States)); Jenkins, E.M.; Mayaux, C.; Obert, W. Los Alamos National Lab., NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910920–4: 4. topical meeting on tritium technology in fission, fusion, and isotopic applications, Albuquerque, NM (United States), 30 Sep - 4 oct 1991). Order Number DE92000205. Source: OSTI; NTIS; INIS; GPO Dep.

The possibility that tritium might exchange with water trapped in aluminum anodize cryopanels in JET prompted a test program at the Tritium Systems Test Assembly, TSTA, Los Alamos, New Mexico. JET furnished two test pieces of cryopanel which were exposed to tritium at approximately liquid nitrogen temperature and 25 torr pressure for nearly two weeks. One specimen was removed and the retained tritium was measured. The second specimen was subjected to several increasing temperature vacuum bakeouts and the effectiveness of the bakeouts were inferred from the pressure history of the chamber. When the retained tritium in the second specimen was measured it was found that nearly 95% of the tritium, as measured in the first specimen, had been removed during the vacuum bakeouts. If the tritium retained in the cryopanel without bakeout were scaled to JET conditions according to a linear pressure time relationship, the tritium expected to become trapped in the JET cryopanels would be approximately 0.6 gram. Testing is currently underway at TSTA which will determine the tritium retention to be expected under more realistic JET operating conditions and which will assess the effectiveness of various bake or purge schemes in removing the trapped tritium. 2 refs., 2 figs.

**35455** (LA-UR–91-3019) **Overview of the Los Alamos National Laboratory Inertial Confinement Fusion Program.** Harris, D.B. Los Alamos National Lab., NM (United States). [1991]. 14p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9106182–3: Annual meeting and symposium of the Fusion Power Associates, Princeton, NJ (United States), 25-26 Jun 1991). Order Number DE92000199. Source: OSTI; NTIS; INIS; GPO Dep.

The Los Alamos Inertial Confinement Fusion (ICF) Program is focused on preparing for a National Ignition Facility. Target physics research is addressing specific issues identified for the Ignition Facility target, and materials experts are developing target fabrication techniques necessary for the advanced targets. We are also working with Lawrence Livermore National Laboratory on the design of the National Ignition Facility target chamber. Los Alamos is also continuing to develop the KrF laser-fusion driver for ICF. We are modifying the Aurora laser to higher intensity and shorter pulses and are working with the Naval Research Laboratory on the development of the Nike KrF laser. 9 refs., 1 fig., 2 tabs.

**35456** (LA-UR–91-3029) **Neutron flux enhancement at LASREF.** Sommer, W.F.; Ferguson, P.D.; Wechsler, M.S. Los Alamos National Lab., NM (United States). [1991]. 16p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-911111–1: International conference on fusion reactor materials, Clearwater, FL (United States), 17-22 Nov 1991). Order Number DE92000196. Source: OSTI; NTIS; INIS; GPO Dep.

The accelerator at the Los Alamos Meson Physics Facility produces a 1-mA beam of protons at an energy of 800 MeV. Since 1985, the Los Alamos Spallation Radiation Effects Facility (LASREF) has made use of the neutron flux that is generated as the incident protons interact with the nuclei in targets and a copper beam stop. A variety of basic and applied experiments in radiation damage and radiation effects have been completed. Recent studies indicate that the flux at LASREF can be increased by at least a factor of ten from the present level of about 5 E+17 $m^{-2}s^{-1}$. This requires changing the beam-stop material from Cu to W and optimizing the geometry of the beam-target interaction region. These studies are motivated by the need for a large volume, high energy, and high intensity neutron source in the development of materials for advanced energy concepts such as fusion reactors. 18 refs., 7 figs., 2 tabs.

**35457** (LA-UR–91-3114) **Tritium technology programs in the United States.** Anderson, J.L. Los Alamos National Lab., NM (United States). [1991]. 12p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910920–5: 4. topical meeting on tritium technology in fission, fusion, and isotopic applications, Albuquerque, NM (United States), 30 Sep - 4 oct 1991). Order Number DE92000172. Source: OSTI; NTIS; INIS; GPO Dep.

Tritium technology in the United States has advanced considerably since the 1988 Tritium Conferences in Toronto. This advance has come in facilities, processing and safety related technologies and in an ever increasing commitment to compliance related issues. The major laboratories in the US tritium programs continue to be (Westinghouse) Savannah River Site, EG&G Mound, Lawrence Livermore National Laboratory, Sandia National Laboratory and the Los Alamos National Laboratory. Each of these Laboratories have made some significant changes in their programs and/or facilities in the past four years. 11 refs, 1 fig.

**35458** (LA-UR–91-3115) **Improved KrF laser design for the Laboratory Microfusion Facility.** Harris, D.B.; Sullivan, J.A.; Pendergrass, J.H.; Kurnit, N.A.; Rose, E.A.; McLeod, J. Los Alamos National Lab., NM (United States). [1991]. 37p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910968–4: 14. IEEE symposium on fusion engineering, San Diego, CA (United States), 30 Sep - 3 oct 1991). Order Number DE92000171. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A conceptual design of the KrF laser-driven Laboratory Microfusion Facility (LMF) has been completed. LASNEX calculations predict an indirect-drive target yield of 400 MJ from the 3-MJ, 480-beam driver system. Nine final amplifiers with individual output energy of 412 kJ are used. The total cost of the KrF laser-driven LMF is estimated by an independent cost assessment to be $921 million in 1992 dollars. 12 refs., 7 figs., 3 tabs.

**35459** (LA-UR–91-3130) **An algorithm for determining EF coils from fixed-boundary equilibria applied to ARIES III.** Bathke, C. (Los Alamos National Lab., NM (United States)); Jardin, S.C.; Kessel, C.E. Los Alamos National Lab., NM (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-910968–3: 14. IEEE symposium on fusion engineering, San Diego, CA (United States), 30 Sep - 3 oct 1991). Order Number DE92000170. Source: OSTI; NTIS; INIS; GPO Dep.

An algorithm that determines the external EF coils required to produce equilibria calculated by high-resolution, fixed-boundary codes is described. The algorithm permits the specification of the poloidal-field-null location. The EF-coil positions on a specified surface located just outside of the TF coils are optimized to minimize the stored magnetic energy. Results of the application of this algorithm to ARIES-3 are also presented. 7 refs., 2 figs., 2 tabs.

**35460** (LBL–30748) **Heavy Ion Fusion Accelerator Research (HIFAR): Half-year report, October 1, 1990–March 31, 1991.** Lawrence Berkeley Lab., CA (United States). Apr 1991. 45p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. (HIFAN–509). Order Number DE92000655. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: emittance variations in current-amplifying ion induction lina; transverse emittance studies of an induction accelerator of heavy ions; drift compression experiments on MBE-4 and related emittance; low emittance uniform-density $C_{s}+$ sources for heavy ion fusion accelerator studies; survey of alignment of MBE-4; time-of-flight dependence on the MBE-4 quadrupole voltage; high order calculation of the multiple content of three dimensional electrostatic geometries; an induction linac injector for scaled experiments; induction accelerator test module for HIF; longitudinal instability in HIF beams; and analysis of resonant longitudinal instability in a heavy ion induction linac.

**35461** (NIFS–84) **Development of the stellarator/heliotron research.** Iiyoshi, A. National Inst. for Fusion Science, Nagoya (Japan). May 1991. 30p. Order Number DE92713935. Source: OSTI; NTIS (US Sales Only); INIS.

The author reviewed the history of the development of the stellarator/heliotron system, and pointed out the important role of the radial electric field in plasma transport in helical devices. (J.P.N.).

**35462** (NIFS-PROC–5, pp. 1-10) **Rayleigh-Taylor Instability in LIB ICF.** Kawata, Shigeo (Nagaoka Univ. of Technology, Niigata

(Japan)): Sato, Toshiaki; Teramoto, Takayuki. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185--: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications.* 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

The Rayleigh-Taylor(R-T) instability is studied in the Light-Ion-Beam(LIB) Inertial-Confinement-Fusion(ICF)-pellet. The R-T instability is one of the problems in ICF. The nonuniform acceleration field and the radiation effects on the LIB-ICF-pellet implosion are investigated by the linear analyses in this paper. By means of these analyses we obtained the following two results: 1) The nonuniform acceleration field in space does not change the growth rate ($\gamma$) of the R-T instability. However this nonuniformity may suppress the R-T instability in some particular cases. 2) The radiation may reduce the growth rate($\gamma$). (author).

**35463** (NIFS-PROC–5, pp. 11-19) **Two-stage ion diode experiments on induction adder.** Miyamoto, S. (Osaka Univ., Suita (Japan). Inst. of Laser Engineering); Yasuda, Y.; Yamamoto, M. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185--: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications.* 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

Two-stage ion diode experiment has been performed on an induction adder accelerator 'Reiden-SHVS'. The second stage diode is operated in an ion beam injection mode. Enhanced space-charge-limited current in second stage diode indicates a formation of virtual anode due to the energetic ion beam injection. The beam deflection by virtual anode formation occurred only at inner part of the beam. Two-stage charge-stripping ion diode is demonstrated. Carbon beam of $C^{+}$ and $C^{2+}$ are stripped and partially recombined in thin stripping foil and accelerated at second diode. (author).

**35464** (NIFS-PROC–5, pp. 45-57) **Theoretical study of 'Plasma Focus Diode'.** Jiang, Weihua (Nagaoka Univ. of Technology, Niigata (Japan)); Masugata, Katsumi; Yatsui, Kiyoshi. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185--: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications.* 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

A theoretical model of self-magnetically insulated, coaxial type ion beam diode, 'Plasma Focus Diode' (PFD), is developed and analyzed in detail. In this theory, self-consistent electron current and space-charge limited ion current are incorporated. The steady-state charge and current distribution inside the diode is calculated for given diode voltage. We compare the calculated diode impedance with the experimental results obtained at the peak power, and good agreement was obtained. Some diode behaviours observed in the experiments are explained by the theory. From the theoretical understanding about PFD, we obtain the scaling relations of diode impedance and the ion-current efficiency, and use them to discuss the possible ways to improve the diode operation. (author).

**35465** (NIFS-PROC–5, pp. 79-88) **Generation and focusing of carbon ion beam by the 'Inverse Pinch Ion Diode'.** Hashimoto, Y. (Himeji Inst. of Tech., Hyogo (Japan)); Sato, M.; Yatsuzuka, M.; Nobuhara, S. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185--: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications.* 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

Focusing of intense ion beams has been attained with the 'Inverse Pinch Ion Diode' which has a flat anode. The energy of the ion beam was 180 keV. At the focal point, the ion current density of 0.5 kA/cm$^2$ has been obtained and the focusing radius of the ion beam (FWHM) is 10 mm. Focusing of the ion beam is due to the electrostatic field in the 'Inverse Pinch Ion Diode'. (author).

**35466** (NIFS-PROC–5, pp. 89-97) **Generation of pulsed ion beams by an inductive storage pulsed power generator.** Katsuki, Sunao (Kumamoto Univ. (Japan)); Akiyama, Hidenori; Maeda, Sadao. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185--: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications.* 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

A pulsed power generator by an inductive energy storage system is extremely compact and light in comparison with a conventional pulsed power generator, which consists of a Marx bank and a water pulse forming line. A compact and light pulsed power generator is applied to the generation of pulsed ion beams. A thin copper fuse is used as an opening switch, which is necessary in the inductive storage pulsed power generator. A magnetically insulated diode is used for the generation of ion beams. The pulsed ion beams are successfully generated by the inductive storage pulsed power generator for the first time. (author).

**35467** (NIFS-PROC–5, pp. 99-107) **Power plant by LIB fusion.** Niu, Keishiro (Tokyo Inst. of Tech. (Japan)); Aoki, Takayuki; Naramoto, Hiroya. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185--: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications.* 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

A fusion power plant of 1GW electric output is proposed here by using proton beam of 12MJ for energy driver. The flibe for the coolant in the reactor cavity with a thickness of 50cm thermalizes the neutrons which produced by fusion reactions and protects the solid wall from being damaged. Tritium-breeding-radio can exceed unity. An indirect-driven-target will implode in a spherically symmetric way even in the nonuniform beam irradiation. (author).

**35468** (NIFS-PROC–5, pp. 109-119) **Control of gap closure in applied-B diode.** Aoki, Takayuki (Tokyo Inst. of Tech. (Japan)); Niu, Keishiro. National Inst. for Fusion Science, Nagoya (Japan). Oct 1990. (CONF-9002185--: Symposium on development of intense pulsed particle beams and its applications, Nagoya (Japan), 20 Feb 1990). In *Symposium on development of intense pulsed particle beams and its applications.* 128p. Order Number DE91780383. Source: OSTI; NTIS (US Sales Only); INIS.

The rapid gap closure due to the build-up of the electron sheath is analyzed by a new one dimensional particle-in-cell code. It is found that the diamagnetic effect of the electrons enhances the ion emission from the anode and increases the amount of the ion charge in the diode gap. The ion charge cancels out the electron charge in the sheath, so that the electron density of the sheath increases and the diamagnetism has more effect on the build-up of the sheath toward the anode. Two methods are proposed to control the gap closure. One is to increase the applied magnetic field and another is to limit the flux emitted at the anode surface. In the simulation results, it is shown that these methods improve the impedance characteristic of the diode. (author).

**35469** (ORNL/TM–11739) **Evaluation of weldments in Type 21-6-9 stainless steel for Compact Ignition Tokamak structural applications: Phase 1.** Alexander, D.J.; Goodwin, G.M.; Bloom, E.E. Oak Ridge National Lab., TN (United States). Jun 1991. 32p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000379. Source: OSTI; NTIS; INIS; GPO Dep.

Primary design considerations for the Compact Ignition Tokamak toroidal field-coil cases are yield strength and toughness in the temperature range from 77 to 300 K. Type 21-6-9 stainless steel, also still known by its original Armco Steel Company trade name Nitronic 40, is the proposed alloy for this application. It has high yield strength and usually adequate base metal toughness, but weldments in thick sections have not been adequately characterized in terms of mechanical properties or hot-cracking propensity. In this study, weldability of the alloy in heavy sections and the mechanical properties of the resultant welds were investigated including tensile yield strength and Charpy V-notch toughness at 77 K and room temperature. Weldments were made in four different

base metals using seven different filler metals. None of the weldments showed any indication of hot-cracking problems. All base metals, including weldment heat-affected zones, were found to have adequate strength and impact toughness at both test temperatures. Weld metals, on the other hand, except ERNiCr-3 and ENiCrFe-3 had impact toughnesses of less than 67 J at 77 K. Inconel 82 had an average weld metal impact toughness of over 135 J at 77 K, and although its strength at 77 K is less than that of type 21-6-9 base metal, at this point it is considered to be the first-choice filler metal. Phase 2 of this program will concentrate on composition refinement and process/procedure optimization for the generic ERNiCr-3 composition and will generate a design data base for base and weld metal, including tensile, fracture toughness, and crack growth rate data.

**35470** (ORNL/TM–11781) **Tritium proof-of-principle pellet injector.** Fisher, P.W. Oak Ridge National Lab., TN (United States). Jul 1991. 71p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000390. Source: OSTI; NTIS; INIS; GPO Dep.

The tritium proof-of-principle (TPOP) experiment was designed and built by Oak Ridge National Laboratory (ORNL) to demonstrate the formation and acceleration of the world's first tritium pellets for fueling of future fusion reactors. The experiment was first used to produce hydrogen and deuterium pellets at ORNL. It was then moved to the Tritium Systems Test Assembly at Los Alamos National Laboratory for the production of tritium pellets. The injector used in situ condensation to produce cylindrical pellets in a 1-m-long, 4-mm-ID barrel. A cryogenic $^3$He separator, which was an integral part of the gun assembly, was capable of lowering $^3$He levels in the feed gas to <0.005%. The experiment was housed to a glovebox for tritium containment. Nearly 1500 pellets were produced during the course of the experiment, and about a third of these were pure tritium or mixtures of deuterium and tritium. Over 100 kCi of tritium was processed through the experiment without incident. Tritium pellet velocities of 1400 m/s were achieved with high-pressure hydrogen propellant. The design, operation, and results of this experiment are summarized. 34 refs., 44 figs., 3 tabs.

**35471** (UCLA/PPG–1200-Vol.1) **The TITAN reversed-field-pinch fusion reactor study: Volume 1: Executive summary: Final report.** California Univ., Los Angeles, CA (United States); General Atomics, San Diego, CA (United States); Los Alamos National Lab., NM (United States); Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Nuclear Engineering. 1990. 202p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER52126 ;AC03-84ER53158 ;FG02-85ER52118 ;W-7405-ENG-36. Order Number DE92000141. Source: OSTI; NTIS; INIS; GPO Dep.

This paper contains the executive summary of the titan revised-field-find fusion reactor study. The general topics covered are: overview of titan plasma engineering; overview of titan-1 fusion power core; and overview of titan-2 fusion power core.

**35472** (UCLA/PPG–1200-Vol.3) **The TITAN reversed-field-pinch fusion reactor study: Volume 3, TITAN-I fusion power core: Final report.** California Univ., Los Angeles, CA (United States); General Atomics, San Diego, CA (United States); Los Alamos National Lab., NM (United States); Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Nuclear Engineering. 1990. 403p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER52126 ;AC03-84ER53158 ;FG02-85ER52118 ;W-7405-ENG-36. Order Number DE92000139. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses research on the titan-1 fusion power core. The major topics covered are: titan-1 fusion-power-core engineering; titan-1 divertor engineering; titan-1 tritium systems; titan-1 safety design and radioactive-waste disposal; and titan-1 maintenance procedures.

**35473** (UCLA/PPG–1200-Vol.4) **The TITAN reversed-field-pinch fusion reactor study: Volume 4, TITAN-2 fusion power core: Final report.** California Univ., Los Angeles, CA (United States); General Atomics, San Diego, CA (United States); Los Alamos National Lab., NM (United States); Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Nuclear Engineering. 1990. 349p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG03-86ER52126 ;AC03-84ER53158 ;FG02-85ER52118 ;W-7405-ENG-36. Order Number DE92000138. Source: OSTI; NTIS; INIS: GPO Dep.

This report discusses the following topics: overview of titan-2 design; titan-2 fusion-power-core engineering; titan-2 divertor engineering; titan-2 tritium systems; titan-2 safety design and radioactive-waste disposal; and titan-2 maintenance procedures.

**35474** (UCRL-ID–106094) **An analysis of grazing incidence metal mirrors in a laser ICF reactor driver.** Bieri, R.; Guinan, M. Lawrence Livermore National Lab., CA (United States). 12 Jul 1991. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000093. Source: OSTI; NTIS; INIS; GPO Dep.

Grazing incidence metal mirrors (GIMMs) are examined to replace dielectric mirrors for the final elements in a laser beam line for an inertial confinement fusion reactor. For a laser driver with a wavelength from 250 to 500 nm in a 10-ns pulse, irradiated mirrors made of Al, Al alloys, or Mg were found to have calculated laser damage limits of 0.3–2.3 J/cm$^2$ of beam energy and neutron lifetime fluence limits of over $5 \times 10^{20}$ 14 MeV n/cm$^2$ when used at grazing incidence and operated at room temperature or at 77 K. A final focusing system including mirrors made of Al alloy 7475 at room temperature or at liquid nitrogen temperatures used with a driver which delivers 5 MJ of beam energy in 32 beams would require 32 mirrors of roughly 10 m$^2$ each. This chapter includes calculations of damage limits for GIMMs and discusses critical issues relevant to the integrity and lifetime of such mirrors in a reactor environment. The reflectivities of various metals are calculated from measured optical constants at room temperature and at cryogenic temperatures for 250- to 500-nm light at both normal and grazing incidence. Then, for the mirrors in a representative system, the thermal absorption and conduction rates of the best candidate metals are used with the maximum allowable cyclic thermal stress to give the maximum allowed surface-temperature rise and surface thermal load. The allowed surface thermal load and surface reflectivity give the maximum beam energy density and the minimum size for each mirror. For mirrors made of aluminum alloy 7475 and initially operated at room temperature, the resulting optical damage threshold and allowable temperature rise give a required mirror size for each final mirror. Critical issues relevant to the integrity and lifetime of such mirrors in a reactor environment are briefly discussed.

## 99 GENERAL AND MISCELLANEOUS

**35475** (DOE/ER–0497) **Guide for the preparation of proposals for the Pre-Freshman Enrichment Program (PREP), 1992: Notice of Program Solicitation No. 71.** USDOE Office of Energy Research, Washington, DC (United States). Office of University and Science Education Programs; Associated Western Universities, Inc., Salt Lake City, UT (United States). Aug 1991. 39p. Sponsored by USDOE, Washington, DC (United States). DOE Contract PS05-92ER79030. Order Number DE91018499. Source: OSTI; NTIS; GPO Dep.

The Pre-Freshman Enrichment Program (PREP) is aimed at increasing the number of underrepresented minority and women students entering all science and mathematics-based professions. This focus reflects the need to broaden the US science and engineering base. The Department of Energy (DOE) is concerned about the availability of science and engineering professionals to perform its mission and is authorized to assure an adequate supply of manpower for the accomplishment of energy research and development programs by sponsoring and assisting education and training activities. The primary purpose of PREP is to help alleviate manpower shortages in science-based careers by preparing students for, and motivating them to take, college-preparatory courses in science and mathematics. The Pre-Freshman Enrichment Program (PREP) will provide funds to colleges and universities for projects aimed at seeking out populations, typically underrepresented in science-based careers, during junior high school and early high school years (sixth through tenth grades) and providing them with pre-freshman enrichment experiences. These experiences shall consist of activities to identify, motivate and prepare

students for science-based careers. Applicants must describe intended outcome for each PREP project and show how these outcomes are to be measured. Established programs should describe previous program outcomes. It is highly desirable that the PREP activities of the proposing institution be correlated with and built upon the broader activities of the national efforts for improving science and mathematics education in the US. This guide for application to PREP includes copies of the required forms.

**35476** (ORNL/tr–91/7) **Lift-off tape and its use.** Korpman, R. (Johnson Johnson, (New Brunswick, NY)). Oak Ridge National Lab., TN (United States). [1991]. 23p. Translation of German Patent No. 28,33,243, February 15, 1979. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91017793. Source: OSTI; NTIS; GPO Dep.

This report describes the invention of an adhesive tape. The tape could be used for typewriter correction ribbon applications. (JL).

**35477** (ORNL/tr–91-9) **Transfer materials.** Blair, S.D.; Elbert, D.L.; Waldrip, G.A. Oak Ridge National Lab., TN (United States). 1991. 21p. Translation of German Patent Application No. 2,335,838, February 21, 1974. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91017792. Source: OSTI; NTIS; GPO Dep.

This report describes the invention of typewriter correction ribbons. A tape formulation and production method is detailed. (JL)

**35478** (ORNL/tr–91-13) **Heat-transfer material.** Katayama, Masahito (Canon Inc., Tokyo (Japan)); Sato, Hiroshi; Takizawa, Yoshihisa; Asaoka, Masanobu; Fukuda, Tsugihiro. Oak Ridge National Lab., TN (United States). [1991]. 28p. Translation of Japanese Kokai Patent No. Sho 63[1988]-309493, December 16, 1988. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91017723. Source: OSTI; NTIS; GPO Dep.

The present invention concerns heat-transfer material used for heat transfer recording, especially heat-transfer material providing good recorded images on a substrate of poor surface smoothness, and the images can be corrected by a liftoff correction tape that produces adhesive properties when heated.

## 9901 Management

*Refer also to citation(s) 33721, 33748, 33795, 33865, 34065, 34071, 34072, 34073, 34095, 34110, 34161, 34213, 34242, 34782, 34971, 35018, 35029, 35504, 35547, 35564*

**35479** (DOE/EH–0208P) **Organizational Cultural Assessment of the Solar Energy Research Institute.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (United States). Jun 1991. 80p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018649. Source: OSTI; NTIS; GPO Dep.

An Organizational Cultural Assessment (OCA) was performed at the Solar Energy Research Institute (SERI) by administering an Organizational Culture Survey (OCS) that queried employees on the subjects of organizational culture, various aspects of communications, employee commitment, work group cohesion, coordination of work, environmental concerns, hazardous nature of work, safety and overall job satisfaction. The purpose of the OCS is to measure in a quantitative and objective way the notion of "culture;" that is, the values, attitudes, and beliefs of the individuals working within the organization. In addition, through the OCS, a broad simple of individuals can be reached that would probably not be interviewed or observed during the course of a typical assessment. The OCS also provides a descriptive profile of the organization at one point in time that can then be compared to a profile taken at a different point in time to assess changes in the culture of the organization. All data from the OCS is presented in group summaries, by division, supervisory level, and staff classification. Statistically significant differences between groups are identified and discussed. The most notable finding which emerges from the OCA conducted at SERI is that it is a very homogeneous organization as indicated by the few statistically significant differences found between divisions/offices, staff classifications, and supervisory levels. The results also indicate SERI to be an organization which places a large amount of emphasis on those behaviors which are considered "constructive" (i.e., Humanistic-Encouraging, Affiliative, Achievement, Self-Actualizing) and, although to a lesser extent, on those behaviors which could be regarded as "passive/defensive" (i.e., Approval, Conventional, Dependent, Avoidance). 9 refs., 11 figs., 6 tabs.

**35480** (DOE/OR/00033–T452) **University programs and facilities in nuclear science and engineering: Seventh edition.** Oak Ridge Associated Universities, Inc., TN (United States). Jan 1991. 156p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-76OR00033. Order Number DE91018192. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy is pleased to publish the seventh edition of University Programs and Facilities in Nuclear Science and Engineering. This publication presents the results of the recent "Survey of University Programs and Facilities in Nuclear Science and Engineering," a voluntary survey conducted by Oak Ridge Associated Universities for DOE. The collection of data for this publication helps DOE meet its mandated obligation to "assure an adequate supply of manpower for ··· energy research and development programs by ··· dissemination of necessary manpower supply and demand data." Furthermore, the data assists the Office of Energy Research in its "responsibility to advise the Secretary with respect to education and training activities required for effective ··· research activities of the Department." This publication presents detailed information for 110 universities and colleges with nuclear and nuclear-related programs/facilities relevant to DOE's mission. In addition to providing needed information for DOE, the publication should be useful to government agencies, university faculty and administrators, students, as well as to DOE contractors and private sector companies.

**35481** (EUR-ICP-CEH–076(S)) **Working group on public health preparedness for nuclear accidents in the near field, Badhoevedorp, Netherlands, 11-14 October 1988: Summary report.** World Health Organization, Copenhagen (Denmark). Regional Office for Europe. 1989. 5p. (CONF-8810551–: Working group on public health preparedness for nuclear accidents in the near field, Badhoevedorp (Netherlands), 11-14 Oct 1988). Source: OSTI; NTIS (US Sales Only); INIS.

Also issued in French, German and Russian.

This report summarizes the conclusions and recommendations of a working group on the planning of measures to safeguard public health in the event of a nuclear accident. Treatment of irradiated and contaminated people was discussed, and countermeasures such as evacuation or sheltering and iodine prophylaxis were considered. The importance of public information was stressed, and it was recommended that public health authorities develop programmes to select ways of educating and preparing communities located close to the site of a potential nuclear accident.

**35482** (HMI-B–485) **HMI annual report 1990.** Hahn-Meitner-Institut Berlin GmbH (Germany). 1991. 152p. (In German). Order Number DE92714363. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the activities of the Hahn-Meitner-Institut (HMI) on four special subjects: 1. Nuclear physics (nuclear reactions, nuclear structure, VICKSI accelerator development), 2. photochemical energy conversion (basic and material research, radiation chemistry), 3. structure research (theory of many-body systems, solid-state physics, neutron scattering, highly stressed metallic materials, trace nutrients in health and nutrition), and 4. information technics (software, real time systems, semiconductor subassembly). The following is presented for every special subject: a) the topics worked on in 1989, b) selected results and c) publications, lectures, theses submitted for diplomas and doctoral theses. (orig.).

**35483** (JAERI-M–91-038) **A translation of NUREG-1355, 'The status of recommendations of the President's Commission on the accident at Three Mile Island - a ten year review'.** Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1991. 114p. Translation of NUREG-1355. (In Japanese). Order Number DE92713850. Source: OSTI; NTIS (US Sales Only); INIS.

Twelve years passed since the TMI accident in March 1979. Actions taken as a consequence of this accident in the United States (U.S.) for better assurance of nuclear power plant resulted in

significant changes in nuclear regulation and plant safety management. These actions also resulted in reorientation in nuclear safety research including initiation of new research projects. These actions were taken in response to recommendations made by the President's Commission (named Kemmeny Commission) which was appointed by the President two weeks after the accident initiation. In 1989, the U.S. Nuclear Regulatory Commission (USNRC) issued a report (NUREG-1355) which summarizes its actions taken in response to the recommendations of President's Commission during the ten years after the accident. This report is a translation of this USNRC report. The translation was made by the collaboration of several engineers at JAERI. It is hoped that this translation would help those who are interested in the past and ongoing actions in U.S. (author).

**35484** (KEK-PR-90-3) **Photon Factory activity report, 1990.** National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). 1991. 504p. Order Number DE92704339. Source: OSTI; NTIS (US Sales Only); INIS.

The Photon Factory has grown at a considerable rate, and 600 experiments are carried out in 1991, while the number of users is now 2300 including about 500 from industrial sectors. The use of synchrotron radiation increased from fundamental research to industrial development. The development at the Photon Factory is supported by the capability of the accelerators. At present, the 2.5 GeV PF ring is operated with positrons at the initial beam current of 350 mA. The total operation time was 3500 hours in the fiscal year 1990. The development of an avalanche mode photodiode, the observation of quantum beat in the experiment of nuclear Bragg scattering, the measurement of photo-electron and photo-ion spectroscopy were carried out. The conversion of TRISTAN main ring to an ultrahigh brilliance and high coherence source is planned for the future. The annual PF Symposium was held, and Professor H. Winick gave the lecture 'Ultrahigh brightness and coherent radiation from large storage rings'. In this report, the outline of the Photon Factory and the activities in Divisions of Injector Linac, Light Source and Instrumentation are described. (K.I.).

**35485** (KFK-4925) **List of the scientific publications of the Karlsruhe Nuclear Research Center in 1990.** Kernforschungszentrum Karlsruhe GmbH (Germany). May 1991. 148p. (In German). Order Number DE92714347. Source: OSTI; NTIS (US Sales Only); INIS.

The report contains the titles of all publications from 1990. In the case of patents, all rights established or published during 1990 are indicated: patents, information sheets (DE-OS). The list of publications is ordered according to institutes. Under projects, only published project reports and publications by staff working on the particular projects are listed. Also included are publications printed in the Kernforschungszentrum from research and development plans within the Production Technology Project (PFT) and the project called 'European Research Center for the Control of Air Pollution' (PEF), which were carried out by the Kernforschungszentrum as project sponsor in cooperation with firms and institutes. The list also includes publications of the branch of the Federal Research Institute for Nutrition based at the Kernforschungszentrum. (orig./HP).

**35486** (KUTL-3) **Kyushu University Tandem Accelerator Laboratory report, 1988-1990.** Sagara, Kenshi; Morinobu, Shunpei (eds.). Kyushu Univ., Fukuoka (Japan). Faculty of Science. Mar 1991. 263p. Order Number DE92704337. Source: OSTI; NTIS (US Sales Only); INIS.

Ten years have elapsed since the first beam was obtained from the Kyushu University tandem accelerator. Although the laboratory has achieved successful scientific results, the performance of the accelerator has been on a decline mainly due to the aging. In the last two and a half years, the tandem accelerator has suffered from the fall of terminal voltage to around 8 MV. However, the experimental studies in the laboratory have been active. The utilization of the polarized beams of protons and deuterons to study the scattering of the p+d system, the use of heavy ion beam for the systematic search for the molecular resonance in relatively heavy systems and for the study on reaction mechanism, the use of both light and heavy ion beams for the studies on nuclear engineering, material science and geological science and so on were carried out. The gamma ray spectroscopic study on the state near yrast line was largely hampered by the accelerator troubles, instead, the collaboration with the Niels Bohr Institute provided a wonderful research ground for the studies. (K.I.).

**35487** (LA-12175-MS) **The prioritization of environment, safety, and health activities.** Otway, H.; Puckett, J.M.; von Winterfeldt, D. Los Alamos National Lab., NM (United States). Sep 1991. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. Order Number DE92000089. Source: OSTI; NTIS; GPO Dep.

Federal facilities, including the national laboratories, must bring existing operations into compliance with environment, safety, and health (ES&H) regulations while restoring sites of past operations to conform with today's more rigorous standards. The need for ES&H resources is increasing while overall budgets are decreasing, and the resulting staffing and financial constraints often make it impossible to carry out all necessary activities simultaneously. This stimulated interest in formal methods to prioritize ES&H activities. We describe the development of an approach called MAPP (Multi-Attribute Prioritization Process), which features expert judgment, user values, and intensive user participation in the system design process. We present results of its application to the prioritization of 41 ES&H activities having a total cost of over $25 million. We conclude that the insights gained from user participation in the design process and the formal prioritization results are probably of comparable value. 19 refs., 3 figs., 9 tabs.

**35488** (NIRS-29) **Annual report of National Institute of Radiological Sciences, April 1989 - March 1990.** National Inst. of Radiological Sciences, Chiba (Japan). Jul 1990. 136p. Order Number DE92704341. Source: OSTI; NTIS (US Sales Only); INIS.

This annual report is a compilation of the research activities and achievement in the National Institute of Radiological Sciences (NIRS) in Japan during the fiscal year 1990 (from April 1989 through March 1990). Efforts at the NIRS are particularly aimed at three long term projects: 'risk due to low level radiation exposure to the general population', 'assessment of radiation exposure of the public to radioactivities as related to the environment', and 'food chain and medical use of accelerated heavy ions'. The research covers a wide range of radiological sciences from molecular to environmental studies and medicine including engineering. Topics consists of physics, chemistry, bio-medical science, clinical research, and environmental sciences, covering a total of 80 titles. A list of publications by staff members, activities of research divisions, and organization chart of the NIRS are given in Appendix. (N.K.).

**35489** (NIRS-AR-33) **Annual report of National Institute of Radiological Sciences of the fiscal year 1989.** National Inst. of Radiological Sciences, Chiba (Japan). Dec 1990. 267p. (In Japanese). Order Number DE92704009. Source: OSTI; NTIS (US Sales Only); INIS.

This annual report presents the activities of the National Institute of Radiological Sciences in Japan in the fiscal year 1989. The activities are divided into research, technical aids, training, medical services, management, library or editing, and international cooperation. Research activities are described under the following sections: (I) newly started special researches for 'biological risk evaluation in public exposure' and 'exposure assessment in the environment and the public involved in food chain', and the continuing special research for 'medical use of accelerated heavy ions'; (II) six assigned researches; (III) ordinary researches concerning physics, pharmachochemistry, biology, genetics, pathology and physiology, cell biology, internal exposure, environmental science, clinical research, clinical research for radiation injuries, medical use of heavy particles, environmental radiation ecology, and aquatic radiation ecology; (IV) risk estimation of radiation; (V) actual surveys for Bikini victims, population doses of medical and occupational exposure, and thorotrast exposure; (VI) project research; (VII) radioactivity survey; (VIII) research supported by Science and Technology Agency aids. Appendices include the personnel list and the bibliography of articles reported by the staff. (N.K.) 809 refs.

**35490** (ORNL-6681) **Handbook for state energy emergency planning.** Oak Ridge National Lab., TN (United States); USDOE

Assistant Secretary for International Affairs and Energy Emergencies, Washington, DC (United States). Office of the Deputy Assistant Secretary for Energy Emergencies. Sep 1991. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000403. Source: OSTI; NTIS; GPO Dep.

This document presents some basic ideas about developing plans for dealing with energy shortages and contains a range of topics and considerations that state government officials and planners may wish to review in formulating an energy emergency plan. Those states in advanced stages of plan development might wish to use this document as a means of reviewing their plans or for possible revisions or refinements. This document introduces a number of key factors and options from which states may choose when finalizing their energy emergency plans. The report is intended to serve as a vehicle for improving planning efforts and does not seek to provide criteria by which to judge or compare different states' plans. There are six basic steps to the planning format presented in this report. The remainder of this document builds upon the outline, providing additional detail on such topics as preliminary planning,legal issues, organizational structures, selection of mitigation measures, and historical reviews. Appendix A lists information sources, and Appendix B contains responses to the State Emergency Plan Survey, updated in October 1990.

**35491** (SAND–91-1340C) **The Silver Bullet Skunk Works: Holistic design of the answering system 1300.** Andrews, A.K. Sandia National Labs., Albuquerque, NM (United States). [1991]. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911237–1: 7. Department of Energy workshop on CAE, Knoxville, TN (United States), 29 Dec 1991). Order Number DE91015336. Source: OSTI; NTIS; GPO Dep.

The Silver Bullet Skunk Works, and experimental product realization team at AT&T Consumer Products, designed and shipped a new telephone answering system to market in eight months, approximately one year faster than previous AT&T products of similar complexity. This paper outlines the Design for "X" (DFX) philosophies and the team structure that enabled the group to accelerate the Product Realization Process. The Answering System 1300, developed in record time, was a successful product that met its schedule and cost objectives, and sold out its entire high-volume manufacturing run. Lessons learned from the Skunk Works experience have since been applied to other development activities in AT&T Consumer Products. 3 figs.

**35492** (SAND–91-2090C) **Effective waste minimization in an R&D setting: The program at Sandia National Laboratories.** Reilly, H.E. Sandia National Labs., Albuquerque, NM (United States). [1991]. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109259–2: 1. international congress on environmentally conscious manufacturing, Santa Fe, NM (United States), 18 Sep 1991). Order Number DE91019051. Source: OSTI; NTIS; GPO Dep.

An important aspect of environmentally-conscious operations is adoption of an aggressive waste minimization program. This paper describes the waste minimization and pollution prevention program at Sandia National Laboratories. Although Sandia's approach is patterned after the generic waste minimization models proposed by the Environmental Protection Agency and the Department of Energy, the specifics of implementation, and the potential for payoff, are influenced by the R&D nature of Sandia's work. Key aspects of the program are discussed, including why Sandia is developing and conducting the program; objectives; elements of the program; our approach to implementation; the magnitude of the undertaking; and the expected payoff. 3 refs., 2 figs.

**35493** (SNV–3890) **Risk assessment - a research program aimed at health risks from air pollution in the general environment.** Lindahl-Kiessling, K. (Uppsala Univ. (Sweden). Zoofysiologiska institutionen); Ahlborg, U.; Bylin, G.; Ehrenberg, L.; Hemminki, K.; Lindell, B.; Nilsson, Robert. National Swedish Environment Protection Board, Solna (Sweden). Jan 1991. 52p. (In Swedish). Order Number DE92601581. Source: OSTI; NTIS (US Sales Only); INIS.

The paper presents a new research program for assessment of health risks caused by air pollutants. It is important to develop general methods for quantitative risk assessments and to improve the scientific base materials. (KAE).

**35494** (UCRL-ID–108268) **Sourcing Program: To identify outstanding women and ethnic minorities in research and research management.** Nissen, S.H. Lawrence Livermore National Lab., CA (United States). Aug 1991. 75p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000097. Source: OSTI; NTIS; GPO Dep.

To meet the challenges of the changing demographics and a projected shortage of technically trained workers in the 21st century, Lawrence Livermore National (LLNL) is increasing its commitment to develop a diverse work force with the abilities to carry out the Laboratory's missions. In addition to the recruitment programs already established at LLNL, a sourcing program to identify outstanding women and minorities in research and research management was initiated in the summer of 1990. A research methodology, time table, selection criteria, and data generation strategy were designed and implemented for this program. Through extensive contacts with R&D facilities, women's and minority professional organizations, national research councils, technical professional societies and universities, other sourcing programs were investigated and evaluated and a network of contacts and resources was developed. This report describes the design and implementation of the sourcing program targeting outstanding women and minorities in science and engineering. It details the investigation and evaluation of sourcing programs in other R&D facilities and provides information regarding methods and sources used to identify potential candidates. Conclusions and recommendations are presented. 10 refs., 5 tabs.

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*Refer also to citation(s) 33624, 33644, 33647, 33648, 33736, 33783, 33784, 33788, 33798, 33813, 33820, 33870, 33911, 33963, 33964, 33968, 34037, 34048, 34053, 34060, 34064, 34113, 34210, 34218, 34328, 34332, 34338, 34339, 34351, 34406, 34427, 34500, 34779, 34781, 34789, 34801, 34806, 34824, 34828, 34831, 34843, 34848, 34895, 34913, 34937, 34957, 34958, 34961, 34970, 34971, 34973, 34979, 34989, 35017, 35019, 35023, 35053, 35062, 35072, 35086, 35093, 35097, 35144, 35152, 35153, 35168, 35177, 35178, 35179, 35265, 35317, 35371, 35373, 35413, 35535, 35563*

**35495** (ANL–91/15) **Studying parallel program behavior with upshot.** Herrarte, V.; Lusk, E. Argonne National Lab., IL (United States). Aug 1991. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-31109-ENG-38. Order Number DE91019072. Source: OSTI; NTIS; GPO Dep.

This is a description of and a user's manual for upshot, an X-based graphics tool for viewing log files produced by parallel programs. 5 refs., 3 figs.

**35496** (ANL–91/32) **Parallel programming with PCN.** Foster, I.; Tuecke, S. Argonne National Lab., IL (United States). Sep 1991. 66p. Sponsored by USDOE, Washington, DC (United States); Department of Defense, Washington, DC (United States); National Science Foundation, Washington, DC (United States). DOE Contract W-31109-ENG-38. Contract CCR-8809615;AFOSR-91-0070;ONR-N00014-89-J-3201;N00014-8 Order Number DE91019005. Source: OSTI; NTIS; GPO Dep.

PCN is a system for developing and executing parallel programs. It comprises a high-level programming language, a set of tools for developing and debugging programs in this language, and interfaces to Fortran and C that allow the reuse of existing code in multilingual parallel programs. Programs developed using PCN are portable across many different workstations, networks, and parallel computers. This document provides all the information required to develop parallel programs with the PCN programming system. It includes both tutorial and reference material. It also presents the basic concepts that underlie PCN, particularly where these are likely to be unfamiliar to the reader, and provides pointers to other documentation on the PCN language, programming techniques, and tools. PCN is in the public domain. The latest version of both

the software and this manual can be obtained by anonymous FTP from Argonne National Laboratory at info.mcs.anl.gov.

35497 (CIEMAT–670) **"AJUSTAR" an interactive processor for to Fit, by means of least squares, one variable polynomials (arbitrary degree) at experimental points.** Sanchez, J.J.; Pena, J. Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Madrid (Spain). 1991. 55p. (In Spanish). Order Number DE92700010. Source: OSTI; NTIS (US Sales Only).

In this report is offered, to scientists and technical people, a numeric tool consisting in a FORTRAN program, of interactive use, with destination to make lineal "least squares" fit on any set of empirical observations. The method based in the orthogonal functions (for discrete case), instead of direct solving the equations system, is used. The procedure includes also the optionally facilities of: variable change, direct interpolation, correlation non linear factor, "weights" of the points, confidence intervals (Scheffe, Miller, Student), and plotting results. (Author)

35498 (CONF-8906112–, pp. 85-92) **Torus structure in higher dimensional Hamiltonian systems.** Gyoergyi, G. (Stevens Inst. of Tech., Hoboken, NJ (USA)); Ling, F.H.; Schmidt, G. Argonne National Lab., IL (United States). [1989]. DOE Contract FG02-87ER13740. From 7. symposium on energy engineering sciences; Argonne, IL (United States); 19-21 Jun 1989. In *Proceedings of the seventh symposium on energy engineering sciences: Nonlinear mechanics and mechanical systems.* 239p. Order Number DE90000872. Source: OSTI; NTIS.

Island tori of coupled standard maps are investigated. The study of invariants of the tangent map shows that the tori are embedded in higher dimensional topological spheres. A new numerical method, the quasi surface of sections construction, reveals the torus structure in the nonlinear domain. Scaling laws and estimates for island boundaries are obtained. Arnold diffusion out of the island is found to be nonexistent or exceedingly slow. The measure of phase space occupied by islands, versus that occupied by chaotic trajectories is shown to decline rapidly as the number of degrees of freedom increases.

35499 (CONF-9104300–1) **Using computer experiments to construct a cheap substitute for an expensive simulation model.** Mitchell, T.; Morris, M. Oak Ridge National Lab., TN (United States). [1991]. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. From Interface 1991: computing science and statistics; Seattle, WA (United States); 22-24 Apr 1991. Order Number DE92000421. Source: OSTI; NTIS; GPO Dep.

There is widespread use of computer models as tools in scientific research. As surrogates for physical or behavioral systems, such models can be subjected to experimentation, the goal being to predict how the corresponding real system would behave under certain conditions. For long-running (expensive) model codes, there may be a severe limitation on the number of experiments that can reasonably be done. This motivates the construction of a fast-running (cheap) approximation to the original code, for use in experiments where a large number of runs may be necessary. Here we discuss our approximation of a simulation model for the compression molding of sheet molding compound, applied to the manufacture of an automobile hood. The approximation was constructed using Bayesian interpolation methods for prediction of the movement of the flow front. The predictions were based on data generated by a sequence of computer experiments, using designs chosen according to a type of D-optimality criterion. 8 refs., 1 tab.

35500 (CONF-9105202–) **Proceedings of the first energy research power supercomputer users symposium.** USDOE Office of Energy Research, Washington, DC (United States). Scientific Computing Staff. [1991]. 173p. Sponsored by USDOE, Washington, DC (United States). From 1. energy research power supercomputer users symposium; Gaithersburg, MD (United States); 21-22 May 1991. Order Number DE91018877. Source: OSTI; NTIS; INIS; GPO Dep.

The Energy Research Power Supercomputer Users Symposium was arranged to showcase the richness of science that has been pursued and accomplished in this program through the use of supercomputers and now high performance parallel computers over the last year: this report is the collection of the presentations given at the Symposium. "Power users" were invited by the ER Supercomputer Access Committee to show that the use of these computational tools and the associated data communications network, ESNet, go beyond merely speeding up computations. Today the work often directly contributes to the advancement of the conceptual developments in their fields and the computational and network resources form the very infrastructure of today's science. The Symposium also provided an opportunity, which is rare in this day of network access to computing resources, for the invited users to compare and discuss their techniques and approaches with those used in other ER disciplines. The significance of new parallel architectures was highlighted by the interesting evening talk given by Dr. Stephen Orszag of Princeton University.

35501 (CONF-9109121–4) **The changing face of probability.** Tonn, B.E. (Oak Ridge National Lab., TN (United States)); Valverde A, L.J. Jr. Oak Ridge National Lab., TN (United States). Sep 1991. 13p. Sponsored by USDOE, Washington, DC (United States); Electric Power Research Inst., Palo Alto, CA (United States). DOE Contract AC05-84OR21400. From Symposium on expert system applications for the electric power industry; Boston, MA (United States); 9-11 Sep 1991. Order Number DE91018857. Source: OSTI; NTIS; GPO Dep.

During the course of the past several centuries, the concept of probability has evolved in both interesting and varied ways. In this paper we consider various facets of the conceptual evolution of probability. We begin with a brief historical overview of the earliest conceptions of probability. We then consider the rise of probability in the twentieth century, and some of the central views that have emerged. The paper concludes with a discussion of some of the current trends in modern probability theory. 6 refs., 1 fig.

35502 (DOE/ER/25001–T6) **Cedar Project—Original goals and progress to date: Progress report, January 25, 1991–January 24, 1991.** Cybenko, G.; Kuck, D.; Padua, D.; Gallopoulos, E. Illinois Univ., Urbana, IL (United States). Center for Supercomputing Research and Development. 5 Sep 1991. 64p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-85ER25001. Order Number DE92000032. Source: OSTI; NTIS; GPO Dep.

This report describes: Cedar System Hardware; Compiler and Software Issues on Memory Management; Operating Systems; Compilers; and Multiprocessor Performance on Algorithms and Applications.

35503 (DOE/ER/25041–4) **Computer aided surface representation: [Final report].** Barnhill, R.E. Arizona State Univ., Tempe, AZ (United States). Dept. of Chemical Engineering. 2 Apr 1991. 20p. Sponsored by USDOE, Washington, DC (United States). DOE Contract FG02-87ER25041. Order Number DE91018872. Source: OSTI; NTIS; GPO Dep.

Modern computing resources permit the generation of large amounts of numerical data. These large data sets, if left in numerical form, can be overwhelming. Such large data sets are usually discrete points from some underlying physical phenomenon. Because we need to evaluate the phenomenon at places where we don't have data, a continuous representation (a "surface") is required. A simple example is a weather map obtained from a discrete set of weather stations. (For more examples including multi-dimensional ones, see the article by Dr. Rosemary Chang in the enclosed IRIS Universe). In order to create a scientific structure encompassing the data, we construct an interpolating mathematical surface which can evaluate at arbitrary locations. We can also display and analyze the results via interactive computer graphics. In our research we construct a very wide variety of surfaces for applied geometry problems that have sound theoretical foundations. However, our surfaces have the distinguishing feature that they are constructed to solve short or long term practical problems. This DOE-funded project has developed the premiere research team in the subject of constructing surfaces (3D and higher dimensional) that provide smooth representations of real scientific and engineering information, including state of the art computer graphics visualizations. However, our main contribution is in the development of fundamental constructive mathematical methods and visualization techniques which can be incorporated into a wide

variety of applications. This project combines constructive mathematics, algorithms, and computer graphics, all applied to real problems. The project is a unique resource, considered by our peers to be a de facto national center for this type of research.

**35504** (EGG-EE–9479) **An independent review of the Multi-Path Redundant Avionics Suite (MPRAS) architecture assessment and characterization report.** Johnson, M.R. EG and G Idaho, Inc., Idaho Falls, ID (United States). Feb 1991. 23p. Sponsored by USDOE, Washington, DC (United States); National Aeronautics and Space Administration, Washington, DC (United States). DOE Contract AC07-76ID01570. Order Number DE91018692. Source: OSTI; NTIS; GPO Dep.

In recent years the NASA Langley Research Center has funded several contractors to conduct conceptual designs defining architectures for fault tolerant computer systems. Such a system is referred to as a Multi-Path Redundant Avionics Suite (MPRAS), and would form the basis for avionics systems that would be used in future families of space vehicles in a variety of missions. The principal contractors were General Dynamics, Boeing, and Draper Laboratories. These contractors participated in a series of review meetings, and submitted final reports defining their candidate architectures. NASA then commissioned the Research Triangle Institute (RTI) to perform an assessment of these architectures to identify strengths and weaknesses of each. This report is a separate, independent review of the RTI assessment, done primarily to assure that the assessment was comprehensive and objective. The report also includes general recommendations relative to further MPRAS development.

**35505** (IS–5055) **Signal processing algorithms on parallel architectures: A performance update.** Rover, D.; Tsai, V.; Chow, Yin-Shan; Gustafson, J. Ames Lab., IA (United States). Feb 1991. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-82. Order Number DE92000525. Source: OSTI; NTIS; GPO Dep.

The Burg algorithm is a widely applied and extensively studied signal processing procedure having a structure typical of a class of important batch signal processing algorithms. Its implementation and performance on four different parallel machines were reported in the 1990 Journal of Parallel and Distributed Computing Special Issue on Massively Parallel Computation. The machines were: the Intel iPSC/2, the Denelcor HEP, the NASA/Goodyear MPP, and the Cray X-MP/48. The objective of the work reported here was to extend that study to two new parallel machines: the nCUBE 2 and the MasPar MP-1. These computers are related to the distributed memory systems above (i.e., the iPSC and the MPP, respectively), but use newer technology. In addition to achieving significant performance gains on the new machines compared to machines in the same architectural class, we found that the original study underestimated the scaleability of the algorithm. That is, the algorithm maps efficiently to small-scale as well as large-scale computers, including both SIMD and MIMD distributed memory systems. Improvements in the parallel algorithm are highlighted. Of special import is the use of appropriate performance metrics and performance visualization to characterize the parallelism of the algorithm and lend insight toward understanding and evaluating its performance. 14 refs., 9 figs.

**35506** (KCP–613-4624) **Pulse code modulation data compression for automated test equipment.** Navickas, T.A.; Jones, S.G. Allied-Signal Aerospace Co., Kansas City, MO (United States). Kansas City Div. May 1991. 7p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00613. (CONF-911187–2: International telemetering conference, Las Vegas, NV (United States), 4 Nov 1991). Order Number DE92000464. Source: OSTI; NTIS; GPO Dep.

Development of automated test equipment for an advanced telemetry system requires continuous monitoring of PCM data while exercising telemetry inputs. This requirements leads to a large amount of data that needs to be stored and later analyzed. For example, a data stream of 4 Mbits/s and a test time of thirty minutes would yield 900 Mbytes of raw data. With this raw data, information needs to be stored to correlate the raw data to the test stimulus. This leads to a total of 1.8 Gb of data to be stored and analyzed. There is no method to analyze this amount of data in a reasonable time. A data compression method is needed to reduce the amount of data collected to a reasonable amount. The solution to the problem was data reduction. Data reduction was accomplished by real time limit checking, time stamping, and smart software. Limit checking was accomplished by an eight state finite state machine and four compression algorithms. Time stamping was needed to correlate stimulus to the appropriate output for data reconstruction. The software was written in the C programming language with a DOS extender used to allow it to run in extended mode. A 94–98% compression in the amount of data gathered was accomplished using this method. 1 fig.

**35507** (LA-UR–91-1068) **An assessment of the ModSim/TWOS parallel simulation environment.** Rich, D.O.; Michelsen, R.E. Los Alamos National Lab., NM (United States). [1991]. 17p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-911224–1: 1991 winter simulation conference, Phoenix, AZ (United States), Dec 1991). Order Number DE91011400. Source: OSTI; NTIS; GPO Dep.

The Time Warp Operating System (TWOS) has been the focus of significant research in parallel, discrete-event simulation (PDES). A new language, ModSim, has been developed for use in conjunction with TWOS. The coupling of ModSim and TWOS is an attempt to address the development of large-scale, complex, discrete-event simulation models for parallel execution. The approach, simply stated, is to provide a high-level simulation-language that embodies well-known software engineering principles combined with a high-performance parallel execution environment. The inherent difficulty with this approach is the mapping of the simulation application to the parallel run-time environment. To use TWOS, Time Warp applications are currently developed in C and must be tailored according to a set of constraints and conventions. C/TWOS applications are carefully developed using explicit calls to the Time Warp primitives; thus, the mapping of application to parallel run-time environment is done by the application developer. The disadvantage to this approach is the questionable scalability to larger software efforts; the obvious advantage is the degree of control over managing the efficient execution of the application. The ModSim/TWOS system provides an automatic mapping from a ModSim application to an equivalent C/TWOS application. The major flaw with the ModSim/TWOS system is it currently exists is that there is no compiler support for mapping a ModSim application into an efficient C/TWOS application. Moreover, the ModSim language as currently defined does not provide explicit hooks into the Time Warp Operating System and hence the developer is unable to tailor a ModSim application in the same fashion that a C application can be tailored. Without sufficient compiler support, there is a mismatch between ModSim's object-oriented, process-based execution model and the Time Warp execution model.

**35508** (LA-UR–91-2923) **NFS as a user interface to a high-performance data system.** Mercier, C.W. Los Alamos National Lab., NM (United States). [1991]. 5p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9110219–1: ONC/Network File System (NFS) industry networking conference, Santa Clara, CA (United States), 6-8 Oct 1991). Order Number DE92000254. Source: OSTI; NTIS; GPO Dep.

The Network File System (NFS) will be the user interface to a High-Performance Data System (HPDS) being developed at Los Alamos National Laboratory (LANL). HPDS will manage high-capacity, high-performance storage systems connected directly to a high-speed network from distributed workstations. NFS will be modified to maximize performance and to manage massive amounts of data. 6 refs., 3 figs.

**35509** (LA-UR–91-2924) **Los Alamos National Laboratory's high-performance data system.** Mercier, C.; Chorn, G.; Christman, R.; Collins, B. Los Alamos National Lab., NM (United States). [1991]. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9109276–2: Cray users group conference, Santa Fe, NM (United States), 23-27 Sep 1991). Order Number DE92000223. Source: OSTI; NTIS; GPO Dep.

Los Alamos National Laboratory is designing a High-Performance Data System (HPDS) that will provide storage for

supercomputers requiring large files and fast transfer speeds. The HPDS will meet the performance requirements by managing data transfers from high-speed storage systems connected directly to a high-speed network. File and storage management software will be distributed in workstations. Network protocols will ensure reliable, wide-area network data delivery to support long-distance distributed processing. 3 refs., 2 figs.

**35510** (LA-UR–91-2965) **Algebraic calculation of stroboscopic maps of ordinary, nonlinear differential equations.** Wackerbauer, R. (Max-Planck-Institut fuer Extraterrestrische Physik, Garching (Germany)); Huebler, A.; Mayer-Kress, G. Lawrence Livermore National Lab., CA (United States). 25 Jul 1991. 70p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-36. (CONF-9105242–2: Experimental mathematics: computational issues in nonlinear science, Los Alamos, NM (United States), 20-24 May 1991). Order Number DE92000220. Source: OSTI; NTIS; GPO Dep.

The relation between the parameters of a differential equation and corresponding discrete maps are becoming increasingly important in the study of nonlinear dynamical systems. Maps are well adopted for numerical computation and several universal properties of them are known. Therefore some perturbation methods have been proposed to deduce them for physical systems, which can be modeled by an ordinary differential equation (ODE) with a small nonlinearity. A new iterative, rigorous algebraic method for the calculation of the coefficients of a Taylor expansion of a stroboscopic map from ODE's with not necessarily small nonlinearities is presented. It is shown analytically that most of the coefficients are small for a small integration time and grow slowly in the course of time if the flow vector field of the ODE is polynomial and if the ODE has fixed point in the origin. Approximations of different orders respectively of the rest term are investigated for several nonlinear systems. 31 refs., 16 figs.

**35511** (LBL–27493) **Database system support for simulation data.** Murphy, M.C. Lawrence Berkeley Lab., CA (United States). Jul 1989. 35p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000654. Source: OSTI; NTIS; GPO Dep.

This report addresses database system issues arising in the design, implementation and execution of queuing simulation experiments. The primary goal is to identify new features for inclusion in a custom database system implemented using an extensible database system. Simulation data is first identified as a distinct subset of scientific data. An overview of the experimental process is then presented along with a survey of related simulation environments. A queuing simulation paradigm is described in detail in order to identify the distinguishing characteristics of queuing simulation data and the modes of manipulation. This is the basis for a traditional ER/Relational implementation, which in turn serves as the focus of a complete simulation environment. Difficulties encountered in the use of traditional implementation tools motivate the custom database system extensions. 37 refs., 5 figs., 2 tabs.

**35512** (LBL–29734) **From chaos to order: The MicroStar data acquisition and analysis system.** Rathbun, W. Lawrence Berkeley Lab., CA (United States). Mar 1991. 55p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000663. Source: OSTI; NTIS; GPO Dep.

The MicroStar data acquisition and analysis software consists of several independent processes, although to the user it looks like a single program. These programs handle such functions as data acquisition (if any), data analysis, interactive display and data manipulation, and process monitoring and control. An overview of these processes and functions can be found in the paper as well as a more detailed description and users' guide.

**35513** (LBL–30695) **Reverse engineering tools for software: A small study.** Harvey, E.H. Jr. Lawrence Berkeley Lab., CA (United States). Oct 1990. 11p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000650. Source: OSTI; NTIS; GPO Dep.

Reverse engineering would ideally reconstruct the design information from existing software. It would ideally populate a forward engineering system that would allow future developments to be done with a higher level tool. By contrast, reverse engineering is done often at LBL by a collection of manual means, such as reading the source codes and talking to experts in those codes, along with some disjointed tools to aid in this process. The following discussion provides some information about the various tools in use at LBL. Most of this information comes from my personal work at LBL, mostly for the Physics Division Time Projection Chamber experiment. This is only a small study. Much more work could and needs to be done in this area. In order to keep the scope limited I will try to stay away from detailed issues such as what type of methodology or technology is best. I know that there are many arguments in favor of the newest and latest technology, just as there are arguments for doing things in the old tried and true methods.

**35514** (NAL-TR–1086) **Development of magneto-optic disk operation managing programs for NS system.** Tsuchiya, M. (National Aerospace Laboratory, Tokyo (Japan)). National Aerospace Lab., Chofu, Tokyo (Japan). Nov 1990. 22p. (In Japanese). Order Number DE92709531. Source: OSTI; NTIS (US Sales Only).

For a large capacity storage of the research/development data base in National Aerospace Laboratory (Japan), a reloadable optical storage unit (OSU) was introduced and has been generally operated since 1989. In order to make the OSU available for external storage of user data sets in the numerical simulation system (NS system) also, OSU operation managing programs peculiarly for the NS system have been developed, which realize the transference of amount of data between magnetic and magneto-optic disks. One of the important functions of the programs is to convert user's data in variable format to fixed sector format in order to store them in the OSU. Another important function is user command languages by which the transference is easily implemented. Experiments have shown that the designed effectiveness of the OSU operation managing programs has been achieved. The results imply that utilization and convenience of the NS system are increased. 7 refs., 5 figs., 17 tabs.

**35515** (ORNL/TM–11850) **On finding minimum-diameter clique trees.** Blair, J.R.S. (Tennessee Univ., Knoxville, TN (United States). Dept. of Computer Science); Peyton, B.W. Oak Ridge National Lab., TN (United States). Aug 1991. 40p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE92000386. Source: OSTI; NTIS; GPO Dep.

It is well-known that any chordal graph can be represented as a clique tree (acyclic hypergraph, join tree). Since some chordal graphs have many distinct clique tree representations, it is interesting to consider which one is most desirable under various circumstances. A clique tree of minimum diameter (or height) is sometimes a natural candidate when choosing clique trees to be processed in a parallel computing environment. This paper introduces a linear time algorithm for computing a minimum-diameter clique tree. The new algorithm is an analogue of the natural greedy algorithm for rooting an ordinary tree in order to minimize its height. It has potential application in the development of parallel algorithms for both knowledge-based systems and the solution of sparse linear systems of equations. 31 refs., 7 figs.

**35516** (ORNL/TM–11910) **Economic analysis for the Integrated Booking System (IBS).** Truett, L.F. (Oak Ridge National Lab., TN (United States)); Wheeler, V.V. Oak Ridge National Lab., TN (United States). Aug 1991. 69p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC05-84OR21400. Order Number DE91018521. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Military Traffic Management Command's proposed Integrated Booking System (IBS) will provide automation support for movement of international surface cargo. IBS will operate during peacetime and wartime to book unit and nonunit cargo. This Economic Analysis (EA) provides draft cost estimates over a 10-year life cycle for four alternative strategies. The EA considered costs only for implementation and operation in the Continental United States although IBS will be implemented worldwide. Through the year 2004, costs for Alternative 1, maintain the status quo, are estimated at a total of $11,461,000. Costs for Alternative 2, modify the current systems, are estimated at $11,821,000. Costs for

Alternative 3, develop IBS with a client/server architecture, are estimated at $10,690,500. Costs for Alternative 4, develop IBS on a midrange mainframe computer with terminal access, are estimated at $10,622,900. Alternatives 3 and 4 are preferred from a technological and operational viewpoint as well as from a cost perspective. Alternative 3 provides additional benefits over Alternative 4 because of its downsizing capabilities. Thus, Alternative 3 is the recommended course of action. 25 refs., 4 tabs.

**35517** (PNL-SA-19923) **Education in computational science: Role of the national laboratories.** Dunning, T.H. Jr. Pacific Northwest Lab., Richland, WA (United States). Apr 1991. 9p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-76RL01830. (CONF-9104258-2: Workshop on undergraduate and graduate education in computational science, Baton Rouge, LA (United States), 29-30 Apr 1991). Order Number DE91018823. Source: OSTI; NTIS; GPO Dep.

The National Laboratories operated by the US Department of Energy have, since their very beginning, been at the forefront of research in computational science. Computational physics is at the core of the Department's programs to design nuclear weapons and to tame the fusion process. And, and the focal points of this research and development effort, the Los Alamos and Lawrence Livermore National Laboratories, support two of the largest computer centers in the world. More recently, the Office of Energy Research established the National Energy Research Supercomputer Center at Lawrence National Laboratory and cosponsored the Supercomputer Research Institute at Florida State University. These Centers provide supercomputer access to DOE's basic research programs, including chemistry, materials science, solid state physics nuclear physics, high energy physics, biology and environmental science. The availability of these resources has had a profound impact on these activities, permitting the solution of problems which have heretofore intractable. There is now underway at DOE's Pacific Northwest Laboratory a new research initiative which will have a profound impact on computational molecular science. The computing demands of new research programs are expect to grow dramatically over the next few years as new projects involving such as the molecular systems of increasing size and complexity are undertaken, new staff are added to the program, and extensive collabortive projects are initiated. To provide for the computing needs of these efforts, the computer hardware and software will need to provide state-of-the-art high performance computational and visualization capabilities for simulations while enabling the evaluation and exploitation of promising new computer technologies.

**35518** (SAND-91-1004) **Authentication of byte sequences.** Stearns, S.D. Sandia National Labs., Albuquerque, NM (United States). Jun 1991. 15p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE92000150. Source: OSTI; NTIS; GPO Dep.

Algorithms for the authentication of byte sequences are described. The algorithms are designed to authenticate data in the Storage, Retrieval, Analysis, and Display (SRAD) Test Data Archive of the Radiation Effects and Testing Directorate (9100) at Sandia National Laboratories, and may be used in similar situations where authentication of stored data is required. The algorithms use a well-known error detection method called the Cyclic Redundancy Check (CRC). When a byte sequence is authenticated and stored, CRC bytes are generated and attached to the end of the sequence. When the authenticated data is retrieved, the authentication check consists of processing the entire sequence, including the CRC bytes, and checking for a remainder of zero. The error detection properties of the CRC are extensive and result in a reliable authentication of SRAD data.

**35519** (SAND-91-1037) **Thermal analysis report of the SANDAC V processor module.** Nelson, N.M. Sandia National Labs., Albuquerque, NM (United States). Aug 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE91018889. Source: OSTI; NTIS; GPO Dep.

The case and junction temperatures of selected integrated circuits (ICs) on the processor module of the SANDAC V computer were calculated using "BETAsoft-R," a personal computer, thermal analysis software program. The predicted data was then compared to corresponding IC case temperature measurements from laboratory tests of a functional SANDAC V computer. Although the difference between the actual and calculated values was somewhat higher than expected, the results of the analysis indicate that "BETAsoft-R" identified the critical ICs on the processor module and that it is capable of analyzing printed circuit boards for potential thermal problems before the design layout is finalized. 8 figs., 12 tabs.

**35520** (SAND-91-1168) **The implementation of a standards based heterogeneous network.** Eldridge, J.M.; Tolendino, L.F. Sandia National Labs., Albuquerque, NM (United States). 5 Aug 1991. 18p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE92000608. Source: OSTI; NTIS; GPO Dep.

Computer networks, supporting an organization's activities, are prevalent and very important to the organization's mission. Implementing a heterogenous organizational network allows the staff to select the computing environment that best supports their job requirements. This paper outlines the lessons learned implementing a heterogenous computer network based on networking standards such as TCP/IP and Ethernet. Such a network is a viable alternative to a proprietary, vendor supported network and can provide all the functionality customers expect in a computer network. 2 figs.

**35521** (SAND-91-1252C) **Compile-time partitioning of a non-strict language with side-effects into sequential threads.** Hoch, J.E.; Davenport, D.M.; Grafe, V.G.; Steele, K.M. Sandia National Labs., Albuquerque, NM (United States). [1991]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-911230-1: 3. Institute of Electrical and Electronic Engineers (IEEE) symposium on parallel and distributed processing, Dallas, TX (United States), 1 Dec 1991). Order Number DE91013107. Source: OSTI; NTIS; GPO Dep.

This paper presents a practical algorithm for partitioning a program into sequential threads. A thread is a sequence of instructions, possibly including branches, which can be scheduled as an indivisible unit on a von Neumann-like processor. The partitioning algorithm is designed for a non-strict (but not lazy) language with non-strict data structures and side-effects. The primary target of the proposed compilation strategy is large-scale parallel systems which rely on multithreading at the processor level to tolerate long communication latencies. As such, the algorithm incorporates a mechanism to balance the desire to maximize thread length with the desire to expose useful high-level parallelism. Although this paper focuses on non-strict semantics in conjunction with a parallel multithreaded architecture, the partitioning analysis is equally well suited (with appropriate simplifications) to a non-strict language on a sequential machine or a strict language on a parallel multithreaded machine. Our analysis is accomplished without compromising non-strict semantics and without creating dependencies which sacrifice useful high-level parallelism. It can also exploit known dependency information. The analysis starts with a traditional dataflow graph and partitions it into a set of interrelated threads. 16 refs., 9 figs.

**35522** (SAND-91-1921C) **Shock wave codes at Sandia National Laboratories.** McGlaun, J.M. Sandia National Labs., Albuquerque, NM (United States). 20 Aug 1991. 33p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9107138-2: 18. international symposium on shock waves, Sendai (Japan), 21-26 Jul 1991). Order Number DE91017847. Source: OSTI; NTIS; GPO Dep.

Sandia National Laboratories is very active in developing multidimensional, multi-material shock wave physics codes. One example is the state-of-the-art, three-dimensional Eulerian code CTH which is used at numerous government and university sites. CTH is being ported to both Single Instruction Multiple Data (SIMD) and Multiple Instruction Multiple Data (MIMD) massively parallel computers. The next-generation arbitrary-Lagrangian-Eulerian code RHALE is under development. This paper will discuss these codes.

**35523** (SAND-91-1964C) **Effective path planning through task restriction.** Chen, P.C. Sandia National Labs., Albuquerque, NM (United States). 10 Sep 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789.

(CONF-9105260–1: IEEE conference on robotics and automation, Nice (France), 10 May 1991). Order Number DE91019066. Source: OSTI; NTIS; GPO Dep.

We present a simple and effective path planning algorithm, an essential component in facilitating robot programming, based on a series of plausible task restriction. It is designed to solve "realistic" problems very quickly, at the expense of not being able to solve every problem. First, the notion of "realistic" problems is motivated with heuristic arguments and formalized through task restrictions. Next, an algorithm solving the resulting tasks of interest is provided. We prove its corrections and theoretical efficiency, and demonstrate empirically its effectiveness and speed. We expect our algorithm to be of practical significance based on its simplicity and predicted performance. 9 refs., 7 figs.

**35524** (SAND–91-2115C) **NFS, Kerberos, and UNICOS.** Haynes, R.A. Sandia National Labs., Albuquerque, NM (United States). 25 Sep 1991. 6p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109276–3: Cray users group conference, Santa Fe, NM (United States), 23-27 Sep 1991). Order Number DE92000246. Source: OSTI; NTIS; GPO Dep.

The Network File System (NFS) is used in UNIX-based networks to provide transparent file sharing between heterogeneous systems. Although NFS is well-known for being weak in security, it is widely used and has become a de facto standard. This paper examines the user authentication shortcomings of NFS and the approach Sandia National Laboratories has taken to strengthen it with Kerberos. The implementation on a Cray Y-MP8/864 running UNICOS is described and resource/performance issues are discussed. 4 refs., 4 figs.

**35525** (SAND–91-2116C) **Requirements for a Network Storage Service in a supercomputer environment.** Kelly, S.M. Sandia National Labs., Albuquerque, NM (United States). 26 Sep 1991. 4p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9109276–1: Cray users group conference, Santa Fe, NM (United States), 23-27 Sep 1991). Order Number DE92000245. Source: OSTI; NTIS; GPO Dep.

Sandia National Laboratories has completed a requirements study for a networked mass storage system. The areas of user functionality, network connectivity, and performance were analyzed to determine specifications for a Network Storage Service to operate in supercomputer environment. 4 refs.

**35526** (SAND–91-2257C) **SRIM code management at Sandia National Laboratories.** Sullivan, T.D. Sandia National Labs., Albuquerque, NM (United States). [1991]. 20p. Sponsored by Department of Defense, Washington, DC (United States). DOE Contract AC04-76DP00789. (CONF-9110235–1: Intelligence community modeling group, Ann Arbor, MI (United States), 15-19 Oct 1991). Order Number DE92000952. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The report discusses the conversion of SRIM code to run on a cray XMP-4/16 under CTSS. Also discussed is the conted code. The CONTED Context Editor is a batch editor that makes changes to test files based on context rather than position. The editor applies a modification using as a point of reference a specified static group of text called a "tag," that appears in the base text file. It is designed to operate as a standard UNIX filter program, similar to SED. The tag concept provides for the specification of a more rigorous point of reference for modifications than a line number or pattern of text within a line. CONTED operates on sets of contiguous lines, or "groups," rather than on lines or patterns within a line. Since a group can be composed of a single line, CONTED can be made to operate on a line basis.

**35527** (UCID–17026-Rev.3) **TART and ALICE input manual: Revision 3.** Kimlinger, J.R.; Monson, N.L.; Plechaty, E.F. Lawrence Livermore National Lab., CA (United States). 25 Jan 1990. 59p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000475. Source: OSTI; NTIS; GPO Dep.

This report lists the input for the TART code on the Cray and gives definitions for all input parameters. It also describes code execution, the limitations of the code, and the input for three sample problems.

**35528** (UCRL-JC–107491) **Implementing functional languages to exploit locality.** Wolski, R.; Feo, J.; Cann, D. Lawrence Livermore National Lab., CA (United States). [1991]. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911230–2: 3. Institute of Electrical and Electronic Engineers (IEEE) symposium on parallel and distributed processing, Dallas, TX (United States), 1 Dec 1991). Order Number DE91015121. Source: OSTI; NTIS; GPO Dep.

In the quest for high performance, no obstacle has been as persistent or unyielding as memory latency. It was hoped that dataflow's fine-grain asynchronous model of execution might defeat the memory latency problem. Unable to realize efficient fine-grain systems, the dataflow community is now studying medium-grain and coarse-grain implementations which, like conventional execution models, suffer the effects of memory latency. In this paper, we describe a functional language implementation that automatically exploits locality on cache-coherent multiprocessors. Our system achieves performance improvements reaching 20% for some programs. This study lends further support to the superiority of the functional paradigm for parallel processing. 11 refs., 9 figs.

**35529** (UCRL-JC–108197) **Harnessing the killer micros: Applications from LLNL's massively parallel computing initiative.** Belak, J.F. Lawrence Livermore National Lab., CA (United States). Jul 1991. 13p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-910799–1: Workshop on parallel computation in chemistry, Willowbrook, IL (United States), 17-19 Jul 1991). Order Number DE91018721. Source: OSTI; NTIS; GPO Dep.

Recent developments in microprocessor technology have led to performance on scalar applications exceeding traditional supercomputers. This suggests that coupling hundreds or even thousands of these "killer-micros" (all working on a single physical problem) may lead to performance on vector applications in excess of vector supercomputers. Also, future generation killer-micros are expected to have vector floating point units as well. The purpose of this paper is to present an overview of the parallel computing environment at Lawrence Livermore National Laboratory. However, the perspective is necessarily quite narrow and most of the examples are taken from the author's implementation of a large scale molecular dynamics code on the BBN-TC2000 at LLNL. Parallelism is achieved through a geometric domain decomposition – each processor is assigned a distinct region of space and all atoms contained therein. As the atomic positions evolve, the processors must exchange ownership of specific atoms. This geometric domain decomposition proves to be quite general and we highlight its application to image processing and hydrodynamics simulations as well. 10 refs., 6 figs.

**35530** (UCRL-LR–108186) **A domain decomposition algorithm for solving large elliptic problems.** Nolan, M.P. Lawrence Livermore National Lab., CA (United States). Jan 1991. 114p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE92000096. Source: OSTI; NTIS; GPO Dep.

AN algorithm which efficiently solves large systems of equations arising from the discretization of a single second-order elliptic partial differential equation is discussed. The global domain is partitioned into not necessarily disjoint subdomains which are traversed using the Schwarz Alternating Procedure. On each subdomain the multigrid method is used to advance the solution. The algorithm has the potential to decrease solution time when data is stored across multiple levels of a memory hierarchy. Results are presented for a virtual memory, vector multiprocessor architecture. A study of choice of inner iteration procedure and subdomain overlap is presented for a model problem, solved with two and four subdomains, sequentially and in parallel. Microtasking multiprocessing results are reported for multigrid on the Alliant FX-8 vector-multiprocessor. A convergence proof for a class of matrix splittings for the two-dimensional Helmholtz equation is given. 70 refs., 3 figs., 20 tabs.

**35531** (UCRL-MA–105401) **TAURUS: An interactive post-processor for the analysis codes NIKE3D, DYNA3D, and TOPAZ3D.** Spelce, T. Lawrence Livermore National Lab., CA (United States). May 1991. 81p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. Order Number DE91019012. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report provides an update to the user's manual for the TAURUS finite element analysis post processor. TAURUS is designed for use with the family of nonlinear finite element codes DYNA3D, NIKE3D, and TOPAZ3D developed in the Methods Development Group at Lawrence Livermore National Laboratory and the structural analysis code GEMINI. TAURUS provides the ability to display deformed geometries and contours or fringes of a large number of quantities on meshes consisting of beam, plate, shell, and solid type elements. Time history plotting is also available for a wide variety of primitive and derived quantities. TAURUS is operational on a variety of platforms from workstations to supercomputers. 13 refs., 47 figs.

**35532** (VTT-TIED–1210) **Navigation and positioning of mobile robots.** Maekelae, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Saehkoe- ja Automaatiotekniikan Lab.); Koskinen, K.; Annanpalo, J.; Penttinen, A. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1991. 93p. (In Finnish). Order Number DE92704014. Source: OSTI; NTIS (US Sales Only).

Dead reckoning was studied by combining the direction and distance measurements. Travelled distance was measured by using a microwave based Doppler radar and an odometer. Both these methods were quite accurate. The direction of the vehicle was measured by a magnetic compass. Its performance was degraded by the acceleration of the vehicle. Feasibility of ultrasonic sensors was tested for obstacle detection and contour following. The sensors tested were able to detect obstacles but they could not distinguish between various types of obstacles. Infrared switches were tested for detecting reflecting landmarks. Their operation proved to be very reliable for the application. An infrared distance sensor was used to obtain distance to nearby objects. The reflection properties of the object had a great effect on the reliability of the measurement. Artificial landmarks can be used for marking the route of a mobile robot. These landmarks can be detected by computer vision. The experiments for testing this principle gave promising results. The accelerations and tilts of the machine were monitored by accelerometers and inclinometers. A properly dampened inclinometer can be used for detecting dangerous tilts of a mobile robot. The natural frequency of the accelerometer has to be adjusted according to the vibrations of the vehicle body. Microwave techiques for measuring the vehicle position was studied in cooperation with Swedish Institute of Microelectronics. Laser techniques was also studied for accurate positioning.

**35533** (WHC-SA–1019) **Justification for reporting negative value counting results as an alternative to minimum detectable activity.** Troyer, G.L.; Brown, R.C.; Jones, R.A. Westinghouse Hanford Co., Richland, WA (United States). Mar 1991. 19p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. (CONF-910422–4: International topical conference on methods and applications of radioanalytical chemistry II (MARC-2), Kona, HI (United States), 21-27 Apr 1991). Order Number DE91018165. Source: OSTI; NTIS; GPO Dep.

Proper measurements of sample radioactivity require removal of background activity as a final step in generating an analytical result. When the sample response is within the standard deviation of the background activity, results often are reported as less than detectable or at a minimum detectable activity (MDA) value. Using the MDA creates a truncated distribution or censored data situation. Where a sample point has repeated measurements a bias is introduced. Further, real results can have analytical error statements. These error statements are lost when a MDA is reported. Investigation of a large number of net counting data for low activity sample points suggests that reporting negative results can provide more information than merely truncating to the MDA when results are near background activities. Four cases are examined: method performance, determination of low level activities, general background stability, and quality of results. 10 refs., 5 figs., 1 tab.

## 9903 Information Handling

*Refer also to citation(s) 34055, 34162, 34163, 34164, 34165, 34166, 34167, 34168, 34169, 34170, 34171, 34172, 34175, 34176, 34177, 34178, 34179, 34180, 34181, 34182, 34184, 34185, 34187, 34188, 34189, 34191, 34192, 34193, 34219, 34245, 34348, 34972, 34982, 35010, 35263, 35511, 35516*

**35534** (CONF-9105153–, pp. 1-4) **The energy data base: Why change its name?.** Grissom, M.C. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

Reasons for building the Energy Science and Technology Database (EDB) and for changing its name are discussed. The range of information to be found there is described along with ways this information is used or can be used. How the database has changed and ways it may change are considered. Results from surveys of DIALOG and STN users of the database are reported.

**35535** (CONF-9105153–, pp. 5-16) **Hanford electronic library project.** Carter, N.G. (Pacific Northwest Lab., Richland, WA (USA)); Judy, J.R. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

This paper describes the Hanford Technical Library's Electronic Library Project which makes the library catalog, journal holdings, accession lists, and CD-ROM databases available on the local area network for Hanford site-wide access. The growing diversity of databases sources mixing LAN-based, online, and CD-ROM databases also requires new methods to repackage search results for users. This paper describes new software that merges and sorts citations from multiple databases, eliminates duplicates, matches citations against local holdings, and delivers a quality search product to the customer.

**35536** (CONF-9105153–, pp. 17-21) **From galleys to electronic pages in one fell swoop.** Condouris, R.A. (Lawrence Livermore National Lab., CA (USA)). USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. DOE Contract W-7405-ENG-48. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

Since 1981, our Technical Information Department has been producing reports using traditional publications methods. The author sets type in galleys, print galleys on RC paper, and lay out pages manually. Recently, we added to our Atex-Autologic publishing system three high-resolution, laser imagers; six laser printers; one laser plotter; two Adobe PostScript interpreters; and two Autologic Page-Image Processors, plus ancillary equipment. These additions transformed our traditional publishing shop into a '90s electronic publisher that outputs complete pages on RC paper or film. This transformation created technological and organizational perturbations (plus a few emotional moments).

**35537** (CONF-9105153–, pp. 23-26) **Progress in informal information management: The Central Technical File.** Pasterczyk, C.E. (Sandia National Labs., Livermore, CA (USA)). USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

One objective of the Sandia Technical Library is to improve the management of unpublished, informal information to respond to...information needs and requirements. The Central Technical File (CTF) is an archive of informal documents in Sandia National Laboratories technical programs which has been maintained by the Technical Library since 1952. CTF serves as a corporate memory for the Laboratories. This paper will describe the progress made in the last year to help CTF better meet Library objectives.

**35538** (CONF-9105153–, pp. 27-28) **DOE software management integration at OSTI.** Gorman, P.L. USDOE Office of

Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

The phaseout of the National Energy Software Center and subsequent integration of software management into the other scientific and technical information activities at OSTI will be discussed. This talk will address impacts to both those submitting and those receiving software packages. Discussions will center on reasons for the change in location, requirements for the new activity, services to be offered, and policy implications.

**35539** (CONF-9105153–, pp. 29-31) **The thesaurus: Not extinct after all.** Raridon, M.H. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

The thesaurus is shown as a viable tool in the modern information arena. The past and present views of the thesauri in information science are explored. The use of a thesaurus in online searching is described briefly. OSTI's new thesaurus program expands the horizons of thesaurus building. This program will be demonstrated.

**35540** (CONF-9105153–, pp. 33-40) **The NEPA environmental review and compliance expert system.** Caton, G. (Oak Ridge National Lab., TN (USA)); Haas, R. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. DOE Contract AC05-84OR21400. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

A PC-based system is being developed to assist in the preparation of documentation for the National Environmental Protection Act requirements and other applicable Oak Ridge National Laboratory environmental, safety, and health standards. The system knowledge is contained in a database of regulations grouped into menus and programmed in question-and-answer logic that assigns measures to be taken. Information collected by the system is written to report files and to a database for administrative use.

**35541** (CONF-9105153–, pp. 41-47) **Operational factors in the creation of large full-text databases.** Dickey, L. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. DOE Contract AC01-87RW00084. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

This paper discusses the procedural, organizational, and administrative aspects of large-volume text conversion. The discussion summarizes lessons learned from the conversion of over 250,000 pages of hardcopy documents to digital text and image files. The paper provides a step-by-step analysis of the processes involved in production text conversion operations. Key factors considered are format retention, accuracy requirements, and cost.

**35542** (CONF-9105153–, pp. 59-64) **Team editing with a difference.** Anderson, F.O. (Allied-Signal, Inc., Kansas City, MO (USA)). USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. DOE Contract AC04-76DP00613. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

At the Kansas City Plant, they are experimenting with a team approach to editing technical documents. Phase 1 begins the editing task by creating a file on our electronic editing system, formatting the document, obtaining artwork, and doing some light editing. Then Phase 2 takes that rough document and completes the job. Early indications are that we are reducing turn-around time and improving quality of the product. Also, the staff is showing less evidence of burnout.

**35543** (CONF-9105153–, pp. 65-68) **International information sharing through the Energy Technology Data Exchange.** Teague, T. (Labat-Anderson Inc., Oak Ridge, TN (USA)). USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

The International Energy Technology Data Exchange (ETDE) is an integral part of DOE's Scientific and Technical Information program. By providing a means for 14 nations to ppol and access summaries of energy reports, ETDE helps maintain a ready source of current information for researchers and policymakers alike. This presentation will focus on a history of the Exchange; its structure, services, and products; and its unique role in building a comprehensive, international database.

**35544** (CONF-9105153–, pp. 69-73) **Data Preparation - Productivity and quality.** Mennella, D.A. (Science Applications International Corp., McLean, VA (USA)); Nippert, D.A. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

Data Preparation is often the most expensive portion of total life cycle cost of an information system. This paper describes an approach to studying data preparation activities to improve productivity and quality. The results presented were developed from an instrumental simulation of a full text, image, and cataloging data preparation process.

**35545** (CONF-9105153–, pp. 75-83) **DOE scientific and technical information program update.** Buchanan, W.L. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

The DOE Office of Scientific and Technical Information (OSTI), AD-21, in conjunction with the DOE Office of Information Resources Management Policy, Plans, and Oversight (AD-24) and Information Technology Services and Operations (AD-25), provides Departmental and contractor elements a centralized resource in meeting their Information Resource Management (IRM) related requirements. Several topics of interest relating to the scientific and technical information aspect of this resource from a policy and service perspective are presented.

**35546** (CONF-9105153–, pp. 85-95) **Information technologies in today's information world.** Scott, R.L. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

This paper is a survey of what the author believes are important technology trend issues in the information science area. This survey deals with important desktop applications, which are increasingly becoming the primary drivers in the information processing environment. This paper also provides a brief view into the future technology applications OSTI is pursuing.

**35547** (CONF-9105153–, pp. 97-101) **A perspective of OSTI.** Blanton, J.M. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

Each year TI Meeting attendees tend to ask specific questions about 'what's going on with OSTI' and generally ask for an 'update' on the organization's STI activities. As a result of this interest, a current 'perspective' is being provided this year by OSTI speakers in subject-specific INFOTECH sessions as well as in paper and subsequent TI Meeting presentations. This paper, 'A Perspective of OSTI,' will provide an overview of the organization; its relationship to DOE Headquarters; and information regarding staffing, expertise, capabilities, and services as well as brief information on major '91 activities and current initiatives.

**35548** (CONF-9105153–, pp. 103-110) **Selecting a relational database system with the user in mind: A methodology.** Hohenbrink, K. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

The Office of Scientific and Technical Information (OSTI) is in the process of developing a set of criteria for selecting a relational database management system (RDBMS). Impact and benefit to the online client is of primary concern in this process. This session outlines a database selection method that solicits database clientele input and explains what happens after a relational database is in place. Discussions will include: Identifying the organization's database functional requirements, selecting a pilot project, testing the RDBMS against client needs, and realizing new opportunities.

**35549** (CONF-9105153–, pp. 111-116) **Photography and audio-visual management system overview.** Eads, A.C. (Westinghouse Hanford Co., Richland, WA (USA)). USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. DOE Contract AC06-87RL10930. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

The Hanford Site Photography and Audio-Visual department is automating work-order tracking, billing, inventory, work-flow management, and negative and video tape indexing. Low-resolution images of selected photos will be available to selected local area network users. From the department's perspective, the paper will describe the formal in-house development process, including determination of need, design analysis, technology assessment, documentation, peer review, costs, final design, programming, implementation, and testing.

**35550** (CONF-9105153–, pp. 117-120) **Technology transfer update.** Fornwall, M.D. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

Improving US competitiveness is a national priority and a mission of the Department of Energy. DOE initiated an expanded technology transfer program following a Department-wide (including laboratories) planning effort. The program builds on the existing mechanisms and authorities provided by past technology transfer legislation and serves as the basis for the implementation of the US Competitiveness and Technology Transfer Act of 1989. The planning activities centered on many issues, including: Establishing mechanisms for implementing Cooperative Research and Development Agreements (CRADA), inventorying and discussing DOE (and contractor outreach activities), technology transfer training programs, and technology transfer from production and other nonlaboratory facilities.

**35551** (CONF-9105153–, pp. 121-124) **Developing and managing a communication workshops program.** Danko, J.E. (Pacific Northwest Lab., Richland, WA (USA)); Lee, V.E. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. DOE Contract AC06-76RL01830. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

Pacific Northwest Laboratory has a Communication Workshops Program that currently offers several workshops to improve the writing and presentation skills of its staff. Drawing on their experience, the authors offer suggestions for developing and operating such a program. The discussion includes identifying the workshops, developing appropriate material, managing the program, and administering the workshops.

**35552** (CONF-9105153–, pp. 125-130) **ISDN: High-speed information network of the future(?).** Cook, R.F. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

Integrated Services Digital Network (ISDN) has been called the most significant advancement in telecommunications since replacement of the manual switchboard. The office of the not-so-distant future will see the 3-kHz analog telephone line replaced by high-speed digital services with integrated voice-data workstations on the same line. This paper provides a brief tutorial on ISDN, examines the forces driving and slowing its implementation, and concludes with speculation on ISDN's future.

**35553** (CONF-9105153–, pp. 131-140) **DOE STI User Needs Study - Overview of results.** Finnerty, A.B. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

This paper presents an overview of the results of the Scientific and Technical Information (STI) User Needs Study conducted by OSTI in 1990-91. The purpose of the study was to identify needs for information types, formats, and media within the overall DOE research and development community. Although the primary target population of this study was researchers and scientists (approximately 70% of all respondents), a number of managers and information professionals were also included. Over 700 responses were received from the more than 30 sites and facilities participating in the study.

**35554** (CONF-9105153–, pp. 141-145) **What's new in OSTI online.** Elliot, J.L. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

In order to facilitate searching of the Energy Science and Technology Database on the Integrated Technical Information System (ITIS), OSTI has developed a menu-driven, user-friendly interface called the OSTI Search-Aid Menus (OSAM). Meanwhile, the Joint Committee on Printing (JCP)/Government Printing Office (GPO) Pilot Project, designed to evaluate electronic dissemination of DOE research and development results to Depository Libraries and including a thorough test of the newly completed ITIS gateway and shared cataloging, is well into the implementation stage. SIS users gained a new, specialized database this year, the SIS Published Information Database (SPID). These developments and plans for the very near future, including a networking project with ESnet and a new ITIS screen that allows fast, direct access to the databases, mean that OSTI's online services continue to expand.

**35555** (CONF-9105153–, pp. 147-148) **The DOE research-in-progress file: A potential technology transfer medium.** Whitson, M.O. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

As a result of today's worldwide competition for the development of goods and services and to enhance US prominence in these markets, it is important that we assist US industry by keeping them knowledgeable of DOE R and D programs currently under way. Industry can use this information to pursue cooperative or cost-shared agreements or to further transform research results into viable products for the global marketplace. Your organization's role in building this file will be discussed. A demonstration of the file will also be given.

**35556** (CONF-9105153–, pp. 149-154) **Technical factors in the creation of large full-text databases.** Bradford, R.B. USDOE Office of Scientific and Technical Information, Oak Ridge, TN (United States). 1991. DOE Contract AC01-87RW00084. From Infotech '91; Oak Ridge, TN (United States); 22-23 May 1991. In *INFOTECH '91: DOE Technical Information (TI) Meeting.* 153p. Order Number DE91018074. Source: OSTI; NTIS.

The use of optical character recognition devices in the creation of large full-text databases is discussed. The importance of the limitations on character accuracies of contemporary OCR devices are

noted. The use of multiple OCR devices in a differential processing scheme is described. This technique exploits the decorrelation of errors produced by OCR devices from multiple vendors. Experimental results from applying this technique to documents from the Licensing Support System prototype database are presented. Using plurality voting alone, the number of errors in the composite ASCII character stream are reduced by two-thirds in comparison to the output of the best individual device. Such error reductions would correspond to approximately a 50% reduction in the overall costs of converting the text from such hardcopy documents to electronic form. Extensions to the technique are discussed that can provide even greater savings.

**35557** (DOE/EIA–0204(91/04)) **Energy Information Administration New Releases, July 1991–August 1991.** Jacobus, P. (ed.); Springer, I. USDOE Energy Information Administration, Washington, DC (United States). 10 Sep 1991. 21p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018838. Source: OSTI; NTIS; GPO; GPO Dep.

The newsletter "New Releases" describes the reports and activities by the Energy Information Administration during the previous month. This annotated information describes activities, publications, machine-readable data files, modeling programs, and data compilations, ordering information and order forms are included. (BM)

**35558** (DOE/ER–0500) **FEDIX: The on-line database retrieval service of Government information for colleges, universities, and other organizations: User's guide: Version 4.0, Release 1.0.** USDOE Office of Energy Research, Washington, DC (United States). Sum 1991. 79p. Sponsored by USDOE, Washington, DC (United States). Order Number DE91018496. Source: OSTI; NTIS; GPO Dep.

FEDIX is an on-line information service that links the education community and the federal government to facilitate research, education, and services. The system provides accurate and timely federal agency information to colleges, universities, and other research organizations. There are no registration fees and no access charges for using FEDIX. The only cost involved is that of a phone call. Agencies participating in the FEDIX system include: Department of Energy (DOE), Federal Aviation Administration (FAA), National Aeronautics and Space Administration (NASA), Office of Naval Research (ONR), National Science Foundation (NSF), National Security Agency (NSA), Department of Commerce (DOC), Department of Education (DOEd), and Department of Housing and Urban Development (HUD). Additional government agencies are expected to join FEDIX in the near future. This guide is intended to help users access and utilize the FEDIX system. Because the system requires frequent updating, some menus and tables used as examples in this publication may not exactly match those displayed on the on-line system.

**35559** (JAERI-M–91-015, pp. 63-81) **6. Activities of the radiation shielding information center and a report on codes: Date for high energy radiation transport.** Roussin, R.W. (Oak Ridge National Lab., TN (USA). Radiation Shielding Information Center). Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1991. (CONF-9010368–: 6. seminar on software development in nuclear energy research, Tokai (Japan), 31 Oct - 1 nov 1990). In *Proceedings of the sixth seminar on software development in nuclear energy research.* 194p. Order Number DE91780381. Source: OSTI; NTIS (US Sales Only); INIS.

There has been a strong collaboration between RSIC and the radiation transport community in Japan. From the early days, RSIC has been involved with high energy radiation transport, and over years, it has had interaction with many of the developers of high energy radiation transport computing technology and data libraries, and has been able to collect and disseminate this technology. The current status of this technology is reviewed, and the prospect for the new advancement is examined. RSIC is embedded in the Engineering Physics and Mathematics Division at Oak Ridge National Laboratory. In practice, RSIC is an information analysis center. RSIC has served several communities for their radiation transport needs, and its scope has broadened to include the radiation transport from nuclear weapons, radioisotopes, accelerators, fusion reactors, nuclear wastes, and both natural and man-made radiation in space. The placing of radiation transport literatures in the data base, the publication of reports and the holding of seminars and workshops are carried out. International collaboration and particularly that with Japan are reported. (K.I.).

**35560** (JAERI-M–91-098) **Introduction to SAS on VAX.** Kardaun, O. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)); Miura, Yukitoshi; Matsuda, Toshiaki; Tamai, Hiroshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Jun 1991. 42p. Order Number DE92704284. Source: OSTI; NTIS (US Sales Only); INIS.

To analyse, among others, the H-mode data base, a new version (6.06) of the SAS system has been installed on the VAX 3200 Workstation at JFT-2M. In this report, we summarize how to use SAS interactively (i.e., in 'display manager mode') on this machine. By a didactical example program and its annotated output we illustrate some of the capabilities of SAS. The report is intended to facilitate the access to the SAS documentation by physicists interested in plasma physical applications. (author).

**35561** (LBL–29576) **Data management in heterogeneous environments and its implications to CEDR.** Markowitz, V.M. Lawrence Berkeley Lab., CA (United States). 27 Oct 1990. 28p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000651. Source: OSTI; NTIS; GPO Dep.

We investigate in this report the issue of data management across multiple pre-existing databases characterized by various degrees of heterogeneity. Different approaches to the problem of data management in heterogeneous environments are reviewed and their advantages and disadvantages are discussed. We examine in some detail the problem of schema integration involved in these approaches. We illustrate different aspects of data management in heterogeneous environments with examples from the Comprehensive Epidemiological Data Resource (CEDR) project, and conclude the report with recommendations for CEDR. These recommendations are summarized in this paper.

**35562** (LBL–30953) **MetaBrowser: A combined browsing, query, and analysis tool.** Shoshani, A.; Szeto, E. Lawrence Berkeley Lab., CA (United States). Apr 1991. 21p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC03-76SF00098. Order Number DE92000714. Source: OSTI; NTIS; GPO Dep.

The MetaBrowser design is based on the premise that scientists should not be forced to learn new languages or commands for finding the data they are interested in and for selecting subsets of the data for further analysis. Furthermore, there should be a single system that permits browsing, query, and analysis of the data, so that the scientist does not have to switch between systems. The current version for the MetaBrowser was designed for the DOE CEDR (Comprehensive Epidemiological Data Resource) project, but the same principles can apply to other scientific disciplines. Browsing and query should be combined. It is quite natural for a user to explore the information in the database before deciding what subset of the data to select for further analysis. In general, if there is a large number of datasets (i.e. databases) in the system, then the user would want to find out information about the various datasets (called metadata), before choosing one or more datasets for further exploration. Thus, a metadatabase that holds information about datasets in the systems must exist.

**35563** (SAND–91-1167) **A Sandia telephone database system.** Nelson, S.D.; Tolendino, L.F. Sandia National Labs., Albuquerque, NM (United States); Sandia National Labs., Livermore, CA (United States). Aug 1991. 26p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC04-76DP00789. Order Number DE92000607. Source: OSTI; NTIS; GPO Dep.

Sandia National Laboratories, Albuquerque, may soon have more responsibility for the operation of its own telephone system. The processes that constitute providing telephone service can all be improved through the use of a central data information system. We studied these processes, determined the requirements for a database system, then designed the first stages of a system that meets our needs for work order handling, trouble reporting, and ISDN hardware assignments. The design was based on an extensive set of applications that have been used for five years to

manage the Sandia secure data network. The system utilizes an Ingres database management system and is programmed using the Application-By-Forms tools.

**35564** (UCRL-JC–106995) **Rebels in search of champions: Envisioning the library of the future.** Moulik, A.; Lai, D. Lawrence Livermore National Lab., CA (United States). 21 Jun 1991. 17p. Sponsored by USDOE, Washington, DC (United States). DOE Contract W-7405-ENG-48. (CONF-911243–1: 15. international online meeting, London (United Kingdom), 10-12 Dec 1991). Order Number DE91016606. Source: OSTI; NTIS; GPO Dep.

The traditional role of librarians to secure and provide access to the archives of recorded knowledge is being rapidly challenged on three fronts: the increasing technical sophistication of library users, the wide availability of information management software, and economic pressures on the growth of library collections. While we may argue endlessly about "turf" and "ownership", the real challenge is to forge a new ethic of librarianship which defies the stereotype of the passive provider of information services, explores new models of partnership with users, and champions an interactive environment in which to create the library of the future. The Main Library at Lawrence Livermore National Laboratory is actively engaged in testing experimental models of the library of the future, centered on dynamic user-librarian interactions, versatile information technologies, and on forecasting creative partnerships with library users in different environments. These experiments are described, evaluated, and their implications for future development are explored. 39 refs.

**35565** (WHC-EP–0506) **Program information architecture/ document hierarchy: Proposed.** Woods, T.W. Westinghouse Hanford Co., Richland, WA (United States). Sep 1991. 42p. Sponsored by USDOE, Washington, DC (United States). DOE Contract AC06-87RL10930. Order Number DE92000529. Source: OSTI; NTIS; INIS; GPO Dep.

The Nuclear Waste Management System (NWMS) Management Systems Improvement Strategy (MSIS) (DOE 1990) requires that the information within the computer program and information management system be ordered into a precedence hierarchy for consistency. Therefore, the US Department of Energy (DOE). Office of Civilian Radioactive Waste Management (OCRWM) requested Westinghouse Hanford Company to develop a plan for NWMS program information which the MSIS calls a document hierarchy. This report provides the results of that effort and describes the management system as a "program information architecture." 3 refs., 3 figs.

# Corporate Author Index

This index lists the corporate authors responsible for issuing the documents in this publication which are identified primarily by report number. The corporate names are entered in standardized forms as defined in *DOE Energy Data Base: Corporate Author Entries* (DOE/TIC-4585). Each entry under a corporate name includes the document title and citation number. Three items of information may appear in parentheses: (1) an abbreviation to identify the document type, such as a report; (2) the country of publication, also abbreviated; and (3) the language of the document if non-English (R;US;In French). Author affiliations are not listed in this index.

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Distribution of retention aid in the web of paper machine, 16:33827 (R;FI;In Finnish)
ETRR Energy-efficient buildings and building components: Interim report 1988-1990, 16:34323 (R;FI)
JALO Fuel conversion: Interim report 1988-1990, 16:34394 (R;FI)
KUITU Energy-efficient mechanical pulping: Interim report 1988-1990, 16:34396 (R;FI)
LIEKKI Combustion technology: Interim report 1988-1990, 16:34776 (R;FI)
LVIS-2000 Future building services: Interim report 1988-1990, 16:34322 (R;FI)
NEMO Advanced energy systems and technologies: Interim report 1988-1990, 16:34272 (R;FI)
OPTIMITURVE Peat production based on solar enrgy: Interim report 1988-1990, 16:33604 (R;FI)
RAINA Energy-efficient paper production: Interim report 1988-1990, 16:34395 (R;FI)
Saving of electricity by controlling electrical equipment in the pulp and paper industry, 16:34402 (R;FI;In Finnish)
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Copper recovery from waste water of electrolytic metallurgy by radiation-chemical method, 16:34760 (IA;SU;In Russian)
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| AC05-76OR00033 | **Oak Ridge Associated Universities, Inc., TN (United States)** | |
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| AC05-84OT21400 | **Oak Ridge Y-12 Plant, TN (United States)** | |
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| AC05-91OR21949 | **Bechtel National, Inc., Oak Ridge, TN (United States)** | |
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| AC06-76RL01830 | **Du Pont de Nemours (E.I.) and Co., Wilmington, DE (United States). Explosives Dept.** | |
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| **AC08-88NV10617** | **EG and G Energy Measurements, Inc., Las Vegas, NV (United States)** | |
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| **AC08-89NV10630** | **Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (United States)** | |
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| AC21-88MC24120 | USDOE Morgantown Energy Technology Center, WV (United States) | |
| | 16:33683 | DOE/METC–91/6117 |
| AC21-88MC24218 | USDOE Morgantown Energy Technology Center, WV (United States) | |
| | 16:34283 | DOE/METC–89/6105 |
| AC21-88MC25009 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AC21-88MC25026 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AC21-88MC25166 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AC21-88MC25168 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AC21-88MC25170 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AC21-89MC25115 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AC21-89MC26026 | USDOE Morgantown Energy Technology Center, WV (United States) | |
| | 16:33685 | DOE/METC–91/6117 |
| AC21-89MC26343 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AC21-90MC26024 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AC21-90MC26025 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AC22-84PC70768 | United Technologies Research Center, East Hartford, CT (United States) | |
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| | 16:33627 | DOE/PC/70768–10 |
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| | 16:33629 | DOE/PC/70768–12 |
| | United Technologies Corp., East Hartford, CT (United States). Research Center | |
| | 16:33557 | DOE/PC/70768–9 |
| AC22-85BC10842 | Minnesota Univ., Minneapolis, MN (United States). Dept. of Chemical Engineering and Materials Science | |
| | 16:33656 | DOE/BC/10842–19 |
| AC22-87PC79661 | Catholic Univ. of America, Washington, DC (United States). Combustion and Multiphase Flows Lab. | |
| | 16:33630 | DOE/PC/79661–T9 |
| AC22-87PC79886 | Coal Technology Corp., Bristol, VA (United States) | |
| | 16:33558 | DOE/PC/79886–T1 |
| AC22-87PC79892 | Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (United States). Dept. of Mining and Minerals Engineering | |
| | 16:33541 | DOE/PC/79892–T15 |
| AC22-87PC79938 | Chicago Univ., IL (United States). Dept. of Chemistry | |
| | 16:33561 | DOE/PC/79938–T6 |
| AC22-88PC88943 | Fossil Energy Research Corp., Laguna Hills, CA (United States) | |
| | 16:33601 | DOE/PC/88943–T3 |
| AC22-89BC14473 | Southwest Research Inst., San Antonio, TX (United States) | |
| | 16:33646 | DOE/BC/14473–6 |
| AC22-89PC89758 | Utah Univ., Salt Lake City, UT (United States). Dept. of Metallurgy and Metallurgical Engineering | |
| | 16:33542 | DOE/PC/89758–T4 |
| AC22-89PC89759 | United Technologies Research Center, East Hartford, CT (United States) | |
| | 16:33564 | DOE/PC/89759–T7 |
| AC22-89PC89805 | Little (Arthur D.), Inc., Cambridge, MA (United States) | |
| | 16:33602 | DOE/PC/89805–5 |
| AC22-89PC89876 | Arkansas Univ., Fayetteville, AR (United States). Dept. of Chemical Engineering | |
| | 16:33570 | DOE/PC/89876–T3 |
| AC22-89PC89883 | Consolidation Coal Co., Library, PA (United States). Research and Development Dept. | |
| | 16:33571 | DOE/PC/89883–23 |
| AC22-90BC14202 | Oklahoma Univ., Norman, OK (United States) | |
| | 16:33657 | DOE/BC/14202–5 |
| AC22-90BC14653 | Texas Univ., Austin, TX (United States). Dept. of Petroleum Engineering | |
| | 16:33647 | DOE/BC/14653–2 |
| AC22-90BC14658 | Oklahoma Univ., Norman, OK (United States) | |
| | 16:33648 | DOE/BC/14658–3 |
| AC22-90BC14666 | Hardin-Simmons Univ., Abilene, TX (United States). Fairleigh Dickinson Labs. | |
| | 16:33649 | DOE/BC/14666–4 |

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| AC22-90PC90098 | Textron, Inc., Everett, MA (United States). Textron Defense Systems | |
| | 16:33968 | DOE/PC/90098–T1 |
| | 16:33969 | DOE/PC/90098–T2 |
| AC22-90PC90160 | Atlantic Research Nuclear Corp., Alexandria, VA (United States) | |
| | 16:33634 | DOE/PC/90160–T2 |
| AC22-90PC90174 | Virginia Center for Coal and Minerals Processing, Blacksburg, VA (United States) | |
| | 16:33543 | DOE/PC/90174–T3 |
| AC22-90PC90361 | North Dakota Univ., Grand Forks, ND (United States). Energy and Environmental Research Center | |
| | 16:33980 | DOE/PC/90361–T3 |
| AC22-91PC90048 | Universal Fuel Development Associates, Inc., Grand Forks, ND (United States) | |
| | 16:33574 | DOE/PC/90048–T1 |
| AC22-91PC90183 | Cornell Univ., Ithaca, NY (United States) | |
| | 16:33615 | DOE/PC/90183–T2 |
| AC22-91PC91026 | Advanced Fuel Research, Inc., East Hartford, CT (United States) | |
| | 16:33583 | DOE/PC/91026–T1 |
| AC34-90DP62349 | Rockwell International Corp., Golden, CO (United States). Rocky Flats Plant | |
| | 16:33774 | RFP-Trans–502 |
| | 16:33775 | RFP-Trans–505 |
| | 16:34041 | RFP-Trans–504 |
| | 16:34058 | RFP-Trans–503 |
| | 16:34515 | RFP-Trans–507 |
| | EG and G Rocky Flats, Inc., Golden, CO (United States) | |
| | 16:34514 | RFP–4498 |
| | 16:35018 | RFP–4451 |
| | EG and G Rocky Flats, Inc., Golden, CO (United States). Rocky Flats Plant | |
| | 16:34042 | RFP-Trans–516 |
| | 16:34797 | RFP–4459 |
| | 16:34798 | RFP-Trans–514 |
| | 16:34799 | RFP-Trans–520 |
| | 16:34840 | RFP-Trans–515 |
| | 16:35084 | RFP–4500 |
| AC35-89ER40486 | Superconducting Super Collider Lab., Dallas, TX (United States) | |
| | 16:34869 | SSCL–396 |
| | 16:34882 | SSCL–500 |
| | 16:34883 | SSCL–507 |
| | 16:34912 | SSCL–364 |
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| | 16:34917 | SSCL–406 |
| | 16:34918 | SSCL–484 |
| | 16:34919 | SSCL–487 |
| AI01-90IE10851 | Houston Interamerican Chamber of Commerce, TX (United States) | |
| | 16:34240 | CONF-9006366–Summ. |
| AI08-78ET44802 | Geological Survey, Denver, CO (United States) | |
| | 16:34961 | USGS-OFR–90-37 |
| AI21-83MC20422 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| AI79-86BP63401 | Lawrence Berkeley Lab., CA (United States) | |
| | 16:34334 | LBL–30498 |
| AM03-76SF00010 | Lawrence Berkeley Lab., CA (United States) | |
| | 16:35214 | SLAC-PUB–4977 |
| AS05-76ER03956 | Oak Ridge National Lab., TN (United States) | |
| | 16:35230 | ORNL/CCIP–91/25 |
| AS05-81ER40032 | Brookhaven National Lab., Upton, NY (United States) | |
| | 16:35194 | BNL–46555 |
| | 16:35246 | BNL–44911 |
| | 16:35278 | BNL–44911 |
| | 16:35283 | BNL–44911 |
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| | 16:35292 | BNL–44911 |
| AT06-76EV72012 | Oregon State Univ., Corvallis, OR (United States) | |
| | 16:35085 | RLO–2227-T12-47 |
| | Oregon State Univ., Corvallis, OR (United States). School of Oceanography | |
| | 16:35145 | DOE/EV/72012–T1 |
| BI79-84BP16480 | Oregon State Univ., Corvallis, OR (United States). Dept. of Microbiology | |
| | 16:33852 | DOE/BP/16480–5 |
| BI79-86BP63461 | USDOE Bonneville Power Administration, Portland, OR (United States). Div. of Fish and Wildlife | |
| | 16:33853 | DOE/BP/63461–5 |
| FC03-85DP40200 | Rochester Univ., NY (United States). Lab. for Laser Energetics | |
| | 16:35435 | DOE/DP/40200–166 |
| FC03-87ER60615 | California Univ., Los Angeles, CA (United States). Lab. of Biomedical and Environmental Sciences | |
| | 16:33737 | DOE/ER/60615–T1 |
| FC07-89ID12869 | American Foundrymen's Society, Des Plaines, IL (United States) | |
| | 16:34445 | EGG-M–91291 |
| FC22-83FE60149 | National Inst. for Petroleum and Energy Research, Bartlesville, OK (United States) | |
| | 16:33661 | NIPER–508 |
| | 16:33674 | NIPER–533 |
| FC22-87PC79798 | Radian Corp., Research Triangle Park, NC (United States). Progress Center | |
| | 16:33977 | DOE/PC/79798–T12 |
| FC22-90PC89660 | Pure Air, Allentown, PA (United States) | |
| | 16:33976 | CONF-9109162–1 |
| FC22-90PC90029 | Consortium for Fossil Fuel Liquefaction Science, Lexington, KY (United States) | |
| | 16:33572 | DOE/PC/90029–T1 |
| | 16:33573 | DOE/PC/90029–T3 |
| FC22-91PC90547 | Energy and Environmental Research Corp., Irvine, CA (United States) | |
| | 16:33970 | DOE/PC/90547–T3 |
| FC22-91PC90548 | LIFAC North America, Oakland, CA (United States) | |
| | 16:33981 | DOE/PC/90548–T2 |
| FG01-88FE61614 | Kentucky Coal and Energy Policy Office, Lexington, KY (United States) | |
| | 16:33620 | DOE/FE/61614–T1 |
| FG01-90CE15466 | Missouri Univ., Columbia, MO (United States). Dept. of Civil Engineering | |
| | 16:33613 | DOE/CE/15466–T4 |
| FG02-84ER13295 | Pennsylvania State Univ., University Park, PA (United States) | |
| | 16:34604 | DOE/ER/13295–5 |
| FG02-84ER13299 | Colorado State Univ., Fort Collins, CO (United States) | |
| | 16:34605 | DOE/ER/13299–7 |
| FG02-84ER60227 | State Univ. of New York, Albany, NY (United States). Research Foundation | |
| | 16:34996 | DOE/ER/60227–6 |

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| FG02-85ER13398 | Argonne National Lab., IL (United States) | |
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| FG02-85ER25001 | Illinois Univ., Urbana, IL (United States). Center for Supercomputing Research and Development | |
| | 16:35502 | DOE/ER/25001–T6 |
| FG02-85ER40213 | Arizona Univ., Tucson, AZ (United States). Dept. of Physics | |
| | 16:35184 | DOE/ER/40213–8 |
| FG02-85ER52118 | California Univ., Los Angeles, CA (United States) | |
| | 16:35412 | UCLA/PPG–1200-Vol.2 |
| | 16:35471 | UCLA/PPG–1200-Vol.1 |
| | 16:35472 | UCLA/PPG–1200-Vol.3 |
| | 16:35473 | UCLA/PPG–1200-Vol.4 |
| FG02-85ER52122 | Wisconsin Univ., Madison, WI (United States). Dept. of Electrical and Computer Engineering | |
| | 16:35436 | DOE/ER/52122–6 |
| FG02-85ER53198 | Wisconsin Univ., Madison, WI (United States) | |
| | 16:35383 | DOE/ER/53198–180 |
| | 16:35384 | DOE/ER/53198–181 |
| | Wisconsin Univ., Madison, WI (United States). Dept. of Physics | |
| | 16:35385 | DOE/ER/53198–182 |
| FG02-85ER53207 | Colorado Univ., Boulder, CO (United States) | |
| | 16:35386 | DOE/ER/53207–6 |
| FG02-86ER13556 | Argonne National Lab., IL (United States) | |
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| FG02-86ER13564 | Massachusetts Inst. of Tech., Cambridge, MA (United States) | |
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| FG02-86ER13582 | Colorado State Univ., Fort Collins, CO (United States) | |
| | 16:34607 | DOE/ER/13582–5 |
| FG02-86ER13612 | Lehigh Univ., Bethlehem, PA (United States). Zettlemoyer Center for Surface Studies | |
| | 16:34550 | DOE/ER/13612–7 |
| FG02-86ER45247 | Argonne National Lab., IL (United States) | |
| | 16:35358 | ANL/CP–74020 |
| FG02-86ER52127 | Illinois Univ., Urbana, IL (United States). Fusion Studies Lab. | |
| | 16:35437 | DOE/ER/52127–81 |
| FG02-86ER53223 | New York Univ., NY (United States). Courant Inst. of Mathematical Sciences | |
| | 16:35387 | DOE/ER/53223–169 |
| FG02-86NE37966 | Florida Univ., Gainesville, FL (United States). Dept. of Nuclear Engineering Sciences | |
| | 16:34781 | DOE/NE/37967–T5 |
| FG02-86NE37967 | Florida Univ., Gainesville, FL (United States). Dept. of Nuclear Engineering Sciences | |
| | 16:34781 | DOE/NE/37967–T5 |
| FG02-86NE37968 | Florida Univ., Gainesville, FL (United States). Dept. of Nuclear Engineering Sciences | |
| | 16:34781 | DOE/NE/37967–T5 |
| FG02-86NE37969 | Florida Univ., Gainesville, FL (United States). Dept. of Nuclear Engineering Sciences | |
| | 16:34781 | DOE/NE/37967–T5 |
| FG02-87ER13676 | Argonne National Lab., IL (United States) | |
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| FG02-87ER13759 | Argonne National Lab., IL (United States) | |
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| FG02-87ER13764 | Argonne National Lab., IL (United States) | |
| | 16:34818 | CONF-8906112– |
| | Wisconsin Univ., Milwaukee, WI (United States). Dept. of Mechanical Engineering | |
| | 16:35176 | DOE/ER/13764–9 |
| FG02-87ER25041 | Arizona State Univ., Tempe, AZ (United States). Dept. of Chemical Engineering | |
| | 16:35503 | DOE/ER/25041–4 |
| FG02-87ER40316 | Washington Univ., St. Louis, MO (United States) | |
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| FG02-87ER40328 | Brookhaven National Lab., Upton, NY (United States) | |
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| FG02-87ER40335 | Colorado Univ., Boulder, CO (United States). Dept. of Physics | |
| | 16:35304 | DOE/ER/40335–6 |
| FG02-87ER60519 | Massachusetts General Hospital, Boston, MA (United States). Physics Research Lab. | |
| | 16:35099 | DOE/ER/60519–T3 |
| FG02-88ER13820 | Argonne National Lab., IL (United States) | |
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| | City Univ. of New York, NY (United States). Research Foundation | |
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| FG02-88ER13946 | Argonne National Lab., IL (United States) | |
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| FG02-88ER13968 | Wisconsin Univ., Madison, WI (United States). Dept. of Horticulture | |
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| FG02-88ER25053 | New York Univ., NY (United States). Courant Inst. of Mathematical Sciences | |
| | 16:35177 | DOE/ER/25053–6 |
| FG02-88ER40388 | Brookhaven National Lab., Upton, NY (United States) | |
| | 16:35299 | BNL–44911 |
| FG02-88ER40406 | Washington Univ., St. Louis, MO (United States). Dept. of Chemistry | |
| | 16:35258 | DOE/ER/40406–4 |
| FG02-88ER40414 | Rochester Univ., NY (United States) | |
| | 16:35259 | DOE/ER/40414–4 |
| FG02-88ER40465 | Massachusetts Inst. of Tech., Cambridge, MA (United States). Plasma Fusion Center | |
| | 16:34858 | DOE/ER/40465–T2 |
| FG02-88ER45341 | Columbia Univ., New York, NY (United States). School of Mines | |
| | 16:34549 | CONF-910874–2 |
| FG02-88ER60636 | Johns Hopkins Univ., Baltimore, MD (United States). School of Hygiene and Public Health | |
| | 16:35093 | DOE/ER/60636–T4 |
| FG02-89ER14039 | State Univ. of New York, Binghamton, NY (United States) | |
| | 16:34734 | DOE/ER/14039–2 |
| FG02-89ER14079 | Colorado School of Mines, Golden, CO (United States). Center for Wave Phenomena | |
| | 16:35144 | DOE/ER/14079–10 |
| FG02-89ER14080 | Delaware Univ., Newark, DE (United States). Dept. of Chemistry and Biochemistry | |
| | 16:33916 | DOE/ER/14080–2 |

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| FG02-90ER14146 | Illinois Univ., Urbana, IL (United States) | |
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| FG02-90ER25084 | State Univ. of New York, Albany, NY (United States). Research Foundation | |
| | 16:35178 | DOE/ER/25084–2 |
| FG02-90ER61058 | Wisconsin Univ., Madison, WI (United States). Space Science and Engineering Center | |
| | 16:34956 | DOE/ER/61058–1 |
| FG02-90ER61060 | Massachusetts Univ., Amherst, MA (United States). Microwave Remote Sensing Lab. | |
| | 16:34963 | DOE/ER/61060–1 |
| FG02-90ER61064 | Atmospheric and Environmental Research, Inc., Cambridge, MA (United States) | |
| | 16:35313 | DOE/ER/61064–1 |
| FG02-91ER40613 | Texas A and M Univ., College Station, TX (United States). Dept. of Physics | |
| | 16:34888 | DOE/ER/40613–1 |
| FG02-91ER61139 | Eleanor Roosevelt Inst. for Cancer Research, Denver, CO (United States) | |
| | 16:35095 | DOE/ER/61139–1 |
| FG03-81SF11634 | Golden Gate Energy Center, Sausalito, CA (United States) | |
| | 16:34271 | DOE/SF/11634–T1 |
| FG03-85ER13314 | Argonne National Lab., IL (United States) | |
| | 16:34814 | CONF-8906112– |
| FG03-86ER52126 | California Univ., Los Angeles, CA (United States) | |
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| | 16:35471 | UCLA/PPG–1200-Vol.1 |
| | 16:35472 | UCLA/PPG–1200-Vol.3 |
| | 16:35473 | UCLA/PPG–1200-Vol.4 |
| FG03-86SF16308 | Dayton Univ., OH (United States). Research Inst. | |
| | 16:33866 | DOE/SF/16308–T2 |
| FG03-87ER13727 | Argonne National Lab., IL (United States) | |
| | 16:34431 | CONF-8906112– |
| FG03-87ER13757 | Argonne National Lab., IL (United States) | |
| | 16:34812 | CONF-8906112– |
| FG03-87ER53256 | Applied Microwave Plasma Concepts, Inc., Carlsbad, CA (United States) | |
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| | 16:35389 | DOE/ER/53256–2 |
| | 16:35390 | DOE/ER/53256–3 |
| FG03-88ER53275 | Texas Univ., Austin, TX (United States). Inst. for Fusion Studies | |
| | 16:35391 | DOE/ET/53088–518 |
| FG03-88ER60676 | Stanford Univ., CA (United States) | |
| | 16:35094 | DOE/ER/60676–T1 |
| FG05-80ET53088 | Texas Univ., Austin, TX (United States). Inst. for Fusion Studies | |
| | 16:35391 | DOE/ET/53088–518 |
| FG05-83OR21389 | CONEG Policy Research Center, Inc., Washington, DC (United States) | |
| | 16:33846 | DOE/OR/21389–32 |
| | 16:33847 | DOE/OR/21389–33 |
| FG05-85ER13435 | Georgia Inst. of Tech., Atlanta, GA (United States). School of Chemistry and Biochemistry | |
| | 16:34587 | DOE/ER/13435–6 |
| FG05-86ER40256 | Texas A and M Univ., College Station, TX (United States). Cyclotron Inst. | |
| | 16:35256 | DOE/ER/40256–6 |
| FG05-86ER40261 | Virginia Univ., Charlottesville, VA (United States). Dept. of Physics | |
| | 16:35268 | UM-HE–90-28 |
| FG05-87ER13735 | Virginia Univ., Charlottesville, VA (United States). Inst. of Nuclear and Particle Physics | |
| | 16:35303 | CONF-9010183–5 |
| | Argonne National Lab., IL (United States) | |
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| FG05-87ER40310 | Texas A and M Univ., College Station, TX (United States) | |
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| FG05-88ER13833 | Virginia Commonwealth Univ., Richmond, VA (United States) | |
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| FG05-88ER13838 | Argonne National Lab., IL (United States) | |
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| FG05-88ER13839 | Argonne National Lab., IL (United States) | |
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| FG05-88ER13865 | Tennessee Univ., Knoxville, TN (United States) | |
| | 16:34608 | DOE/ER/13865–042 |
| FG05-88ER53279 | National Academy of Sciences, Washington, DC (United States). Board on Physics and Astronomy | |
| | 16:35376 | DOE/ER/53279–1 |
| FG05-89ER14054 | Texas A and M Univ., College Station, TX (United States) | |
| | 16:35092 | DOE/ER/14054–2 |
| FG05-90ER40592 | Duke Univ., Durham, NC (United States). Dept. of Physics | |
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| FG06-89RL11746 | Advanced Environmental Research Group, Inc., Woolwich, ME (United States) | |
| | 16:34317 | DOE/RL/11746–T2 |
| FG06-90ER40537 | Washington Univ., Seattle, WA (United States). Dept. of Physics | |
| | 16:35305 | DOE/ER/40537–9 |
| FG07-88ER12823 | Rensselaer Polytechnic Inst., Troy, NY (United States). Dept. of Nuclear Engineering and Engineering Physics | |
| | 16:33724 | DOE/ER/12823–2 |
| FG07-89ID12855 | EG and G Idaho, Inc., Idaho Falls, ID (United States) | |
| | 16:34444 | EGG-M–91290 |
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| FG21-86MC23139 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| FG21-88MC25031 | USDOE Morgantown Energy Technology Center, WV (United States) | |
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| FG21-89MC26015 | USDOE Morgantown Energy Technology Center, WV (United States) | |
| | 16:34284 | DOE/METC–89/6105 |
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| 46517 | 16:35192 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000484 | MF-414 |
| 46540 | 16:33812 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018726 | MF-902 |
| 46546 | 16:35193 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018729 | MF-414 |
| 46549 | 16:34988 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000126 | MF-401 |
| 46550 | 16:34989 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000127 | MF-401 |
| 46555 | 16:35194 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000135 | MF-414 |
| 46562 | 16:33547 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000131 | MF-109 |
| 46568 | 16:35111 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000132 | MF-408 |
| 46573 | 16:35255 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000128 | MF-413 |
| 46579 | 16:35195 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000477 | MF-414 |
| 46582 | 16:34871 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000482 | MF-406; MF-414 |
| 46589 | 16:34763 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000485 | MF-408 |
| 46592 | 16:34887 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000474 | MF-410 |
| 46608 | 16:34872 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000483 | MF-406; MF-414 |
| BNL-NUREG– | | | | | |
| 46511-Rev. | 16:34115 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018727 | |
| 46542 | 16:34116 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018730 | |
| BONN-ME– | | | | | |
| 91-01 | 16:35302 | OSTI; NTIS (US Sales Only); INIS | | DE92714446 | |
| BIS-ISH– | | | | | |
| 149/90 | 16:35110 | OSTI; NTIS (US Sales Only); INIS | | DE92714366 | |
| CEA-CONF– | | | | | |
| 10509 | 16:34777 | OSTI; NTIS (US Sales Only) | | DE92703744 | |
| 10514 | 16:35271 | OSTI; NTIS (US Sales Only) | | DE92703746 | |
| CEA-LNS-GT– | | | | | |
| 91-05 | 16:34873 | OSTI; NTIS (US Sales Only) | | DE92707140 | |
| CEA-N– | | | | | |
| 2660 | 16:35154 | OSTI; NTIS (US Sales Only) | | DE92707157 | |
| CIEMAT– | | | | | |
| 628 | 16:34924 | OSTI; NTIS (US Sales Only) | | DE92700001 | |
| 641 | 16:35071 | OSTI; NTIS (US Sales Only) | | DE92700002 | |
| 642 | 16:34990 | OSTI; NTIS (US Sales Only) | | DE92700003 | |
| 660 | 16:34582 | OSTI; NTIS (US Sales Only) | | DE92700004 | |
| 663 | 16:34583 | OSTI; NTIS (US Sales Only) | | DE92700005 | |
| 664 | 16:34584 | OSTI; NTIS (US Sales Only) | | DE92700006 | |
| 665 | 16:33835 | OSTI; NTIS (US Sales Only) | | DE92700007 | |
| 668 | 16:33986 | OSTI; NTIS (US Sales Only) | | DE92700008 | |
| 669 | 16:34991 | OSTI; NTIS (US Sales Only) | | DE92700009 | |
| 670 | 16:35497 | OSTI; NTIS (US Sales Only) | | DE92700010 | |
| 672 | 16:34117 | OSTI; NTIS (US Sales Only) | | DE92700011 | |
| 673 | 16:34764 | OSTI; NTIS (US Sales Only) | | DE92700012 | |
| 675 | 16:34925 | OSTI; NTIS (US Sales Only) | | DE92700013 | |
| 677 | 16:34926 | OSTI; NTIS (US Sales Only) | | DE92700014 | |
| CONF-8707230– | | (2. Meeting of the National Working Group for Reduction in Transuranic Waste Arisings (NWGRTWA); Livermore, CA (United States); 28-29 Jul 1987) | | | |
| Summ. | 16:33745 | *See* DOE/JIO–024 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-8810551– | | (Working group on public health preparedness for nuclear accidents in the near field; Badhoevedorp (Netherlands); 11-14 Oct 1988) | | | |
| | 16:35481 | *See* EUR-ICP-CEH–076(S) | | | |
| CONF-8810552– | | (Workshop on development and construction of gravitational wave emitter and detector; Dubna (USSR); 11-13 Oct 1988) | | | |
| | 16:35155 | *See* JINR-D–4-89-221 | | | |
| CONF-8902110– | | (2. international symposium on the fourth family of quarks and leptons; Santa Monica, CA (United States); 23-25 Feb 1989) | | | |
| 6 | 16:35214 | *See* SLAC-PUB–4977 | | | |
| CONF-8903109– | | (5. international aluminum-lithium conference; Williamsburg, VA (United States); 28-31 Mar 1989) | | | |
| 6 | 16:34504 | *See* LBL–26928 | | | |
| CONF-890398– | | (DOE/LLNL symposium on explosion-source phenomenology; Lake Tahoe, CA (United States); 14-16 Mar 1989) | | | |
| 1 | 16:34980 | *See* UCRL-JC–107941 | | | |
| 3 | 16:35153 | *See* UCRL-JC–108142 | | | |
| CONF-8905115– | | (2. international workshop on real-time computing of the environmental consequences of an accidental release to the atmosphere from a nuclear installation; Luxembourg (Luxembourg); 16-19 May 1989) | | | |
| | 16:34162 | *See* EUR–12320-Vol.2 | | | |
| CONF-8905210– | | (International conference on synchrotron radiation application; Hefei (China); 9-12 May 1989) | | | |
| 4 | 16:34863 | *See* LBL–27437 | | | |
| CONF-8908286– | | (International workshop on wind energy; Roskilde (Denmark); 21-25 Aug 1989) | | | |
| | 16:33919 | *See* RISO-M–2879 | | | |
| CONF-8910545– | | (Conference on fireside problems while incinerating municipal and industrial waste; Sheraton Palm Coast, U (United States); 8-12 Oct 1989) | | | |
| 1 | 16:33844 | *See* ETSU-B–7052S | | | |
| CONF-8911162– | | (NWWA/API conference on petroleum hydrocarbons and organic chemicals in ground water; Houston, TX (United States); 15-17 Nov 1989) | | | |
| 1 | 16:35053 | *See* EGG-M–89238 | | | |
| CONF-8911321– | | (4. workshop on elementary-particle picture of the universe; Tateyama (Japan); 22-25 Nov 1989) | | | |
| | 16:35165 | *See* KEK-PR–90-1 | | | |
| CONF-8912155– | | (2. REM Workshop on Real Time Radioactivity Monitoring and its Interface with predictive Atmospheric Transport Modelling; Ispra (Italy); 5-6 Dec 1989) | | | |
| | 16:35009 | *See* EUR–12990 | | | |
| CONF-891261– | | (Lasers '89: 12th international conference on lasers and applications; New Orleans, LA (United States); 3-8 Dec 1989) | | | |
| Exc. | 16:34842 | *See* ENEA-RT-INN–90-02 | | | |
| CONF-9001159– | | (Workshop on the cooling of advanced reactors; Kumatori (Japan); 18 Jan 1990) | | | |
| | 16:34040 | *See* KURRI-TR–344 | | | |
| CONF-9003288– | | (1990 national IEE convention; No City Given (Japan); 28-30 Mar 1990) | | | |
| 1 | 16:34220 | *See* ANL-Trans–90-13 | | | |
| CONF-9003293– | | (IEA/BA TASK 6: activity 4 meeting - comminution, storage and drying of wood fuels; Firenze (Italy); 19-21 Mar 1990) | | | |
| | 16:33838 | *See* NEI-DK–636 | | | |
| CONF-9003295– | | (Conference on health physics; Kumatori (Japan); 20 Mar 1990) | | | |
| | 16:35338 | *See* KURRI-TR–347 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-900466– | | (Spring meeting of the Materials Research Society (MRS); San Francisco, CA (United States); 16-21 Apr 1990) | | | |
| 102 | 16:34506 | *See* LBL–28964 | | | |
| CONF-9005247– | | (International conference on radiation material science; Alushta (USSR); 22-25 May 1990) | | | |
| | 16:34428 | *See* INIS-SU–273/A | | | |
| | 16:34455 | *See* INIS-SU–272 | | | |
| CONF-900531– | | (1. international symposium on the biological processing of coal; Orlando, FL (United States); 1-3 May 1990) | | | |
| 7 | 16:33598 | *See* PNL-SA–17644 | | | |
| CONF-9005347– | | (17. all-union Chugaev conference on complex compound chemistry; Minsk (USSR); 29-31 May 1990) | | | |
| | 16:34579 | *See* INIS-SU–253/A | | | |
| CONF-9005373– | | (5. all-union conference on radiation heterogeneous processes; Kemerovo (USSR); 28-31 May 1990) | | | |
| | 16:35342 | *See* INIS-SU–266 | | | |
| CONF-900623– | | (15. American Society for Testing and Materials (ASTM) international symposium on effects of radiation on materials; Nashville, TN (United States); 17-22 Jun 1990) | | | |
| 27 | 16:33828 | *See* PNL-SA–19650 | | | |
| CONF-9006366– | | (Houston Interamerican Chamber of Commerce (HICC) 1990 Latin American energy forum; Houston, TX (United States); 26-27 Jun 1990) | | | |
| Summ. | 16:34240 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017950 | MF-700 |
| CONF-9007145– | | (SUR/FIN '90: 77th American Electroplaters and Surface Finishers Society (AESF) annual technical conference; Boston, MA (United States); 9-12 Jul 1990) | | | |
| 4 | 16:34372 | *See* EGG-M–90299 | | | |
| CONF-9007215– | | (9. all-union conference on chemistry of inorganic fluorides; Cherepovets (USSR); 3-6 Jul 1990) | | | |
| | 16:34686 | *See* INIS-SU–276 | | | |
| CONF-900764– | | (Fatigue '90: 4th international conference on fatigue and fatigue thresholds; Honolulu, HI (United States); 15-20 Jul 1990) | | | |
| 4 | 16:34505 | *See* LBL–28244 | | | |
| CONF-9008222– | | (Workshop on the accelerator for particle therapy; Kumatori (Japan); 22-23 Aug 1990) | | | |
| | 16:35105 | *See* KURRI-TR–342 | | | |
| CONF-9008225– | | (Specialists' meeting on physics and engineering of fission and spallation; Specialists' meeting on physics and engineering of fission and spallation; Kumatori (Japan); KUMATORI (Japan); 2 Aug 1990; 10 jan 1991) | | | |
| | 16:35264 | *See* KURRI-TR–345 | | | |
| CONF-9009185– | | (11. Riso international symposium on metallurgy and materials science: structural ceramics processing microstructure and properties; Riso (Denmark); 3-7 Sep 1990) | | | |
| 1 | 16:35106 | *See* PNL-SA–19901 | | | |
| CONF-900921– | | (International conference on acid deposition: its nature and impacts; Glasgow (United Kingdom); 16-21 Sep 1990) | | | |
| 2 | 16:35005 | *See* ETDE-IT–91-54 | | | |
| CONF-900924– | | (9. international symposium on high energy spin-physics; Bonn (Germany); 10-15 Sep 1990) | | | |
| 16 | 16:35268 | *See* UM-HE–90-28 | | | |
| CONF-9009292– | | (4. advanced ICFA beam dynamics workshop on collective effects in short bunches; Tokyo (Japan); 22-29 Sep 1990) | | | |
| | 16:34874 | *See* KEK–90-21 | | | |
| CONF-9009423– | | (Technical committee meeting on post-irradiation examination techniques for water reactor fuel; Workington (United Kingdom); 11-14 Sep 1990) | | | |
| | 16:34777 | *See* CEA-CONF–10509 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9009427– | | (Conference on photochemical processes in organized molecular systems; Yokohama (Japan); 22-24 Sep 1990) | | | |
| 1 | 16:35170 | *See* ANL/CP–73037 | | | |
| CONF-900944– | | (1990 applied superconductivity conference; Snowmass, CO (United States); 24-28 Sep 1990) | | | |
| 51 | 16:34917 | *See* SSCL–406 | | | |
| 52 | 16:34916 | *See* SSCL–405 | | | |
| 53 | 16:34915 | *See* SSCL–404 | | | |
| 54 | 16:34914 | *See* SSCL–403 | | | |
| CONF-900958– | | (7. annual international Pittsburgh coal conference; Pittsburgh, PA (United States); 10-14 Sep 1990) | | | |
| 4 | 16:33584 | *See* EGG-M–90355 | | | |
| CONF-9010128– | | (14. Europhysics conference on nuclear physics: rare nuclear decays and fundamental processes; Bratislava (Czechoslovakia); 22-26 Oct 1990) | | | |
| 5 | 16:35186 | *See* ANL-HEP-CP–90-122 | | | |
| CONF-9010183– | | (European workshop on hadronic physics with electrons beyond 10 GeV; Dourdan (France); 8-12 Oct 1990) | | | |
| 5 | 16:35303 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018755 | MF-413 |
| CONF-9010243– | | (International collaboration on advanced neutron sources (ICANS); Tsukuba (Japan); 21-26 Oct 1990) | | | |
| | 16:34893 | *See* KEK–90-25(v.1) | | | |
| | 16:34894 | *See* KEK–90-25(v.2) | | | |
| CONF-9010383– | | (BIOMOVS (biosperic model validation study) symposium on the validity of environmental transfer models; Stockholm (Sweden); 8-10 Oct 1990) | | | |
| 1 | 16:35072 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018844 | MF-408 |
| CONF-9010404– | | (36. Brazilian congress of geology; Natal (Brazil); 28 Oct - 1 nov 1990) | | | |
| | 16:35150 | *See* INIS-BR–2698 | | | |
| CONF-9010427– | | (All-German symposium on legal protection for the environment in the unified Germany; Wuerzburg (Germany); 12-13 Oct 1990) | | | |
| | 16:34028 | *See* FFU-rep–90-12 | | | |
| CONF-901105– | | (Fall meeting of the Materials Research Society (MRS); Boston, MA (United States); 24 Nov - 1 dec 1990) | | | |
| 129 | 16:34567 | *See* LBL–30112 | | | |
| 130 | 16:34540 | *See* LBL–29284 | | | |
| CONF-901116– | | (11. international conference on the application of accelerators in research and industry; Denton, TX (United States); 5-8 Nov 1990) | | | |
| 42 | 16:34860 | *See* KFK–4808 | | | |
| CONF-901165– | | (4. joint US-CERN school on particle accelerators: course on frontiers of particle beams: intensity limitations; Hilton Head Island, SC (United States); 7-14 Nov 1990) | | | |
| 2 | 16:34896 | *See* LA-UR–91-3012 | | | |
| CONF-9012111– | | (12. lecture meeting of Arbeitsgemeinschaft der Grossforschungseinrichtungen (AGF): Environment and cancer; Bonn (Germany); 13-14 Dec 1990) | | | |
| | 16:35133 | *See* INIS-mf–14008 | | | |
| CONF-901226– | | (4. international symposium on neutron capture therapy; Sydney (Australia); 3-7 Dec 1990) | | | |
| 7 | 16:35100 | *See* DOE/ER/60874–2 | | | |
| CONF-901283– | | (4. Mexican school on particles and fields; Oaxtepec (Mexico); 3-14 Dec 1990) | | | |
| 2 | 16:35227 | *See* FNAL/C–91/200 | | | |
| CONF-910110– | | (19. international workshop on gross properties of nuclei; Hirschegg (Austria); 14-26 Jan 1991) | | | |
| | 16:35271 | *See* CEA-CONF–10514 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9101105– | | (Workshop on high energy physics phenomenology; Calcutta (India); Jan 1991) | | | |
| 2 | 16:35195 | *See* BNL–46579 | | | |
| CONF-9101112– | | (15. workshop on the mass of the electron neutrino; Tsukuba (Japan); 10 Jan 1991) | | | |
| | 16:35207 | *See* KEK–90-22 | | | |
| CONF-9101113– | | (X-ray binaries and the formation of binary and millisecond radio pulsars; Santa Barbara, CA (United States); 21-25 Jan 1991) | | | |
| 1 | 16:35169 | *See* UCRL-JC–108046 | | | |
| CONF-9101117– | | (Specialists' meeting on physics and engineering of fission and spallation; Specialists' meeting on physics and engineering of fission and spallation; Kumatori (Japan); KUMATORI (Japan); 2 Aug 1990; 10 jan 1991) | | | |
| | 16:35264 | *See* KURRI-TR–345 | | | |
| CONF-910123– | | (OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium; Los Angeles, CA (United States); 20-25 Jan 1991) | | | |
| 35 | 16:34568 | *See* LBL–30148 | | | |
| CONF-910204– | | (Society for Mining, Metallurgy and Exploration (SME) annual meeting and exhibit; Denver, CO (United States); 25-28 Feb 1991) | | | |
| 1 | 16:33778 | *See* SAND–90-1785 | | | |
| CONF-9102139– | | (Symposium on 'radiation research in life science'; Kumatori (Japan); 26-28 Feb 1991) | | | |
| | 16:35120 | *See* KURRI-TR–350 | | | |
| CONF-9103166– | | (2. international symposium on particles, strings and cosmology; Boston, MA (United States); 25-30 Mar 1991) | | | |
| 5 | 16:35209 | *See* LA-UR–91-3136 | | | |
| CONF-9103180– | | (30. Schladming winter school on nuclear physics: Recent aspects of quantum fields; Schladming (Austria); 27 Feb - 8 mar 1991) | | | |
| | 16:35362 | *See* DESY–91-038 | | | |
| CONF-9103200– | | (26. Rencontres de Moriond conference; Les Arcs (France); 10-24 Mar 1991) | | | |
| | 16:35226 | *See* DESY–91-061 | | | |
| 2 | 16:35210 | *See* LBL–30734 | | | |
| CONF-910340– | | (3. annual international industrial symposium on the super collider (IISSC); Atlanta, GA (United States); 13-15 Mar 1991) | | | |
| 48 | 16:34913 | *See* SSCL–391 | | | |
| 49 | 16:34869 | *See* SSCL–396 | | | |
| 50 | 16:34912 | *See* SSCL–364 | | | |
| CONF-910357– | | (March meeting of the American Physical Society (APS); Cincinnati, OH (United States); 18-22 Mar 1991) | | | |
| 1 | 16:34245 | *See* SAND–91-1840 | | | |
| CONF-910396– | | (1. European biennial workshop on nuclear physics; Megeve (France); 25-29 Mar 1991) | | | |
| | 16:35307 | *See* GSI–91-29(prepr.) | | | |
| CONF-910399– | | (American Society for Nondestructive Testing spring conference; Oakland, CA (United States); 18-22 Mar 1991) | | | |
| 3-Rev.1 | 16:34839 | *See* UCRL-JC–104111-Rev.1 | | | |
| CONF-9104107– | | (75. annual meeting of the Federation of American Societies for Experimental Biology (FASEB); Atlanta, GA (United States); 21-25 Apr 1991) | | | |
| 1 | 16:35142 | *See* LBL–31097 | | | |
| CONF-910422– | | (International topical conference on methods and applications of radioanalytical chemistry II (MARC-2); Kona, HI (United States); 21-27 Apr 1991) | | | |
| 4 | 16:35533 | *See* WHC-SA–1019 | | | |
| CONF-9104258– | | (Workshop on undergraduate and graduate education in computational science; Baton Rouge, LA (United States); 29-30 Apr 1991) | | | |
| 2 | 16:35517 | *See* PNL-SA–19923 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9104286– | | (Neutral particle beam technical symposium; Boulder, CO (United States); 15-19 Apr 1991) | | | |
| 3 | 16:34870 | *See* ANL/CP–72543 | | | |
| CONF-9104295– | | (KEK workshop on B factory; Tsukuba (Japan); 15-18 Apr 1991) | | | |
| 1 | 16:34910 | *See* SLAC-PUB–5587 | | | |
| CONF-9104298– | | (National Council on Radiation Protection and Measurements (NCRP) annual meeting; Washington, DC (United States); 2-3 Apr 1991) | | | |
| 1 | 16:35111 | *See* BNL–46568 | | | |
| CONF-9104299– | | (1991 Nagoya spring school on dynamical symmetry breaking; Nakatsugawa, Gifu-ken (Japan); 23-27 Apr 1991) | | | |
| 1 | 16:35216 | *See* SLAC-PUB–5619 | | | |
| CONF-9104300– | | (Interface 1991: computing science and statistics; Seattle, WA (United States); 22-24 Apr 1991) | | | |
| 1 | 16:35499 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000421 | MF-405 |
| CONF-9104302– | | (Conference on environmentally sound agriculture; Orlando, FL (United States); 16-18 Apr 1991) | | | |
| 1 | 16:34400 | *See* LBL–30836 | | | |
| CONF-910505– | | (1991 Institute of Electrical and Electronics Engineers (IEEE) particle accelerator conference (PAC); San Francisco, CA (United States); 6-9 May 1991) | | | |
| 406 | 16:34834 | *See* BNL–45726 | | | |
| 407 | 16:34902 | *See* LBL–29976 | | | |
| 409 | 16:34865 | *See* LBL–29947 | | | |
| 410 | 16:34900 | *See* LBL–29943 | | | |
| 411 | 16:34901 | *See* LBL–29944 | | | |
| CONF-9105106– | | (Conference on the intersections between particle and nuclear physics; Tucson, AZ (United States); 23-29 May 1991) | | | |
| 29 | 16:35211 | *See* LBL–30849 | | | |
| CONF-9105113– | | (Strings and symmetries conference; Stony Brook, NY (United States); 20-25 May 1991) | | | |
| 3 | 16:35243 | *See* LBL–31192 | | | |
| CONF-9105115– | | (North Atlantic Treaty Organization (NATO) ARW workshop on computation of transport properties in the dilute gas region; Porto Carras (Greece); 28-31 May 1991) | | | |
| 1 | 16:34730 | *See* LA-UR–91-2882 | | | |
| CONF-9105184– | | (5. annual conference on fossil energy advanced research and technology development (AR&TD) of materials; Oak Ridge, TN (United States); 13-16 May 1991) | | | |
| Absts. | 16:33973 | *See* ORNL/M–1524 | | | |
| CONF-9105202– | | (1. energy research power supercomputer users symposium; Gaithersburg, MD (United States); 21-22 May 1991) | | | |
| | 16:35500 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018877 | MF-400 |
| CONF-9105241– | | (4. international conference on elastic and diffractive scattering; Isola D'Elba (Italy); 22-25 May 1991) | | | |
| 2 | 16:35200 | *See* FNAL/C–91/216 | | | |
| CONF-9105242– | | (Experimental mathematics: computational issues in nonlinear science; Los Alamos, NM (United States); 20-24 May 1991) | | | |
| 2 | 16:35510 | *See* LA-UR–91-2965 | | | |
| CONF-9105251– | | (Meeting on the foundation of quantum mechanics; Santa Fe, NM (United States); 27-31 May 1991) | | | |
| 2 | 16:35234 | *See* LA-UR–91-3063 | | | |
| CONF-9105252– | | (11. annual Center for Nonlinear Studies (CNLS) conference; Los Alamos, NM (United States); 20-24 May 1991) | | | |
| 2 | 16:35168 | *See* LA-UR–91-2963 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9105254– | | (7. international conference on pressure vessel technology (ICPVT); Dusseldorf (Germany); 31 May - 5 jun 1991) | | | |
| 1 | 16:34432 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017871 | MF-114 |
| CONF-9105259– | | (95. castings congress; Birmingham, AL (United States); 5-9 May 1991) | | | |
| 1 | 16:34445 | *See* EGG-M–91291 | | | |
| CONF-9105260– | | (IEEE conference on robotics and automation; Nice (France); 10 May 1991) | | | |
| 1 | 16:35523 | *See* SAND–91-1964C | | | |
| CONF-9105263– | | (5. Pisa meeting on advanced detectors; Isola d'Elba (Italy); 26-31 May 1991) | | | |
| | 16:34943 | *See* LBL–31070 | | | |
| 2 | 16:34944 | *See* LBL–31168 | | | |
| CONF-910530– | | (International conference and workshop on modeling and mitigating the consequences of accidental releases of hazardous materials; New Orleans, LA (United States); 6-10 May 1991) | | | |
| 2 | 16:34988 | *See* BNL–46549 | | | |
| CONF-910580– | | (International conference on advanced materials (ICAM 91); Strasbourg (France); 27-31 May 1991) | | | |
| 5 | 16:34541 | *See* LBL–30928 | | | |
| CONF-9106107– | | (International conference on new nuclear physics with advanced techniques; Ierapetra (Greece); 23-29 Jun 1991) | | | |
| 2 | 16:34929 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000448 | MF-413 |
| 3 | 16:34857 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000743 | MF-413 |
| CONF-9106151– | | (12. electromagnetic isotope separators and technique related to their applications; Sendai (Japan); 2-6 Jun 1991) | | | |
| 1 | 16:34923 | *See* ANL/CP–74097 | | | |
| CONF-910617– | | (4. international symposium on ceramic materials and components for engines; Goeteborg (Sweden); 10-12 Jun 1991) | | | |
| 4 | 16:34525 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000043 | MF-332 |
| 5 | 16:34420 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000674 | MF-373 |
| CONF-9106182– | | (Annual meeting and symposium of the Fusion Power Associates; Princeton, NJ (United States); 25-26 Jun 1991) | | | |
| 3 | 16:35455 | *See* LA-UR–91-3019 | | | |
| CONF-9106194– | | (International workshop on pions in nuclei; Penyscola (Spain); 2-9 Jun 1991) | | | |
| | 16:35302 | *See* BONN-ME–91-01 | | | |
| 7 | 16:35311 | *See* LA-UR–91-2988 | | | |
| CONF-9106203– | | (15. actinide separations conference; Charleston, SC (United States); 17-21 Jun 1991) | | | |
| 6 | 16:33729 | *See* WHC-SA–1170 | | | |
| CONF-9106213– | | (15. Department of Energy (DOE) solar photochemistry research conference; Snowmass, CO (United States); 2-6 Jun 1991) | | | |
| | 16:33855 | *See* SERI/CP–2360-4494 | | | |
| CONF-9106230– | | (59. Military Operations Research Society (MORS) symposium; West Point, NY (United States); 11-13 Jun 1991) | | | |
| 2 | 16:34972 | *See* PNL-SA–19432 | | | |
| CONF-9106235– | | (11. Department of Energy workshop on personnel neutron dosimetry; Las Vegas, NV (United States); 4-7 Jun 1991) | | | |
| 4 | 16:34948 | *See* UCRL-JC–107669 | | | |
| 5 | 16:34930 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018581 | MF-707 |
| CONF-910626– | | (6. international conference on emerging nuclear energy systems; Monterey, CA (United States); 16-21 Jun 1991) | | | |
| 7 | 16:34861 | *See* LA-UR–91-2797 | | | |
| 11 | 16:34035 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018245 | MF-700 |
| 13 | 16:35404 | *See* LA-UR–91-2860 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9106274– | | (Symposium on high energy nuclear collisions and quark gluon plasma; Kyoto (Japan); 6-8 Jun 1991) | | | |
| 1 | 16:35193 | *See* BNL–46546 | | | |
| 2 | 16:35194 | *See* BNL–46555 | | | |
| 3 | 16:35208 | *See* LA-UR–91-2891 | | | |
| CONF-9106275– | | (NATO advanced research workshop; Irsee (Germany); 23-29 Jun 1991) | | | |
| 1 | 16:34433 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018852 | MF-404 |
| 2 | 16:34434 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018231 | MF-404 |
| 3 | 16:34511 | *See* LBL–31085 | | | |
| CONF-9106277– | | (1991 powder metallurgy conference; Pittsburgh, PA (United States); 24-26 Jun 1991) | | | |
| 1 | 16:34444 | *See* EGG-M–91290 | | | |
| CONF-9106281– | | (Workshop on neural networks: from biology to high energy physics; Isola d'Elba (Italy); 5-14 Jun 1991) | | | |
| 1 | 16:34937 | *See* FNAL/C–91/241 | | | |
| CONF-9106282– | | (40. American Association for the Advancement of Science (AAAS) Gordon conference on nuclear chemistry; New London, NH (United States); 27 Jun 1991) | | | |
| 1 | 16:34774 | *See* LBL–31134 | | | |
| CONF-9106285– | | (11. international conference on physics in collision; Colmar (France); 20-22 Jun 1991) | | | |
| 1 | 16:35206 | *See* FNAL/C–91/238-E | | | |
| CONF-9106290– | | (IWGFR/IAEA specialists' meeting on properties of structural materials in liquid metal environment; Karlsruhe (Germany); 18-20 Jun 1991) | | | |
| | 16:34021 | *See* INIS-mf–14003 | | | |
| CONF-9106292– | | (4. international conference on nucleus-nucleus collisions (NN-4); Kanazawa (Japan); 10-14 Jun 1991) | | | |
| | 16:35262 | *See* GSI–91-35(prepr.) | | | |
| CONF-9106293– | | (18. European conference on controlled fusion and plasma heating; Berlin ( G is not a valid Country Code.); 3-7 Jun 1991) | | | |
| | 16:35400 | *See* IPP–III/180 | | | |
| CONF-910635– | | (Cryogenic engineering conference and international cryogenic materials conference; Huntsville, AL (United States); 11-14 Jun 1991) | | | |
| 15 | 16:34919 | *See* SSCL–487 | | | |
| 17 | 16:34510 | *See* LBL–31075 | | | |
| CONF-910640– | | (8. IEEE pulsed power conference; San Diego, CA (United States); 17-19 Jun 1991) | | | |
| 44 | 16:34909 | *See* SAND–91-0178C | | | |
| 45 | 16:34849 | *See* SAND–90-3101C | | | |
| CONF-910659– | | (84. annual meeting and exhibition of the Air and Waste Management Association (AWMA); Vancouver (Canada); 16-21 Jun 1991) | | | |
| 33 | 16:35020 | *See* UCRL-JC–106334 | | | |
| CONF-910662– | | (12. international conference on magnet technology; Leningrad (USSR); 23-28 Jun 1991) | | | |
| 1 | 16:34911 | *See* SLAC-PUB–5631 | | | |
| 2 | 16:34885 | *See* BNL–45727 | | | |
| 3 | 16:34877 | *See* LBL–29819 | | | |
| 4 | 16:34876 | *See* LBL–29810 | | | |
| CONF-910707– | | (7. international conference on surface modification of metals by ion beams (SMMIB-7); Washington, DC (United States); 15-19 Jul 1991) | | | |
| 8 | 16:34507 | *See* LBL–31008 | | | |
| CONF-910710– | | (6. international workshop on critical currents in superconductors (IWCCVI); Cambridge (United Kingdom); 7-12 Jul 1991) | | | |
| 4 | 16:34523 | *See* ANL/CP–73491 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9107104– | | (5. international conference on precipitation scavenging and atmosphere surface exchange process: Richland, WA (United States); 15-19 Jul 1991) | | | |
| 15 | 16:34994 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000044 | MF-408 |
| CONF-9107105– | | (1991 American Physical Society (APS) conference on shock compression of condensed matter: Williamsburg, VA (United States); 17-20 Jul 1991) | | | |
| 51 | 16:34573 | *See* SAND–91-1188C | | | |
| 52 | 16:35351 | *See* LA-UR–91-3135 | | | |
| CONF-9107115– | | (Society of Photo-Optical Instrumentation Engineers (SPIE) meeting; San Diego, CA (United States); 21-26 Jul 1991) | | | |
| 43 | 16:34574 | *See* SAND–91-1551C | | | |
| 46 | 16:34960 | *See* UCRL-JC–106888 | | | |
| 47 | 16:35356 | *See* UCRL-JC–106887 | | | |
| 48 | 16:34957 | *See* SAND–91-2046C | | | |
| 49 | 16:34958 | *See* SAND–91-2047C | | | |
| 50 | 16:34854 | *See* SAND–91-2850C | | | |
| CONF-9107138– | | (18. international symposium on shock waves; Sendai (Japan); 21-26 Jul 1991) | | | |
| 2 | 16:35522 | *See* SAND–91-1921C | | | |
| 3 | 16:35453 | *See* LA-UR–91-2876 | | | |
| CONF-9107146– | | (16. international conference on defects in semiconductors; Bethlehem, PA (United States); 22-26 Jul 1991) | | | |
| 3 | 16:35355 | *See* SAND–91-1861C | | | |
| CONF-9107153– | | (Hanford separations workshop; Richland, WA (United States); 23-25 Jul 1991) | | | |
| 2 | 16:34581 | *See* ANL/CP–73631 | | | |
| CONF-9107170– | | (CAP-NSERC workshop on theoretical physics; Ontario (Canada); 28 Jul - 3 aug 1991) | | | |
| 1 | 16:35358 | *See* ANL/CP–74020 | | | |
| CONF-9107172– | | (15. joint international lepton photon symposium at high energies and European Physical Society (EPS) conference on high energy; Geneva (Switzerland); 25 Jul - 1 aug 1991) | | | |
| 1 | 16:35215 | *See* SLAC-PUB–5600 | | | |
| CONF-9107176– | | (1991 IMA semiconductor workshop; Minneapolis, MN (United States); 15 Jul - 9 aug 1991) | | | |
| 1 | 16:35349 | *See* LA-UR–91-2951 | | | |
| CONF-9107177– | | (1991 annual charged particle beam review; Beltsville, MD (United States); 25-29 Jul 1991) | | | |
| 1 | 16:34867 | *See* SAND–91-1975C | | | |
| CONF-9107178– | | (Chemical Research and Development Engineering Center (CRDEC) conference on obscuration and aerosol research; Aberdeen, MD (United States); 23-26 Jul 1991) | | | |
| 1 | 16:34585 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000451 | MF-406 |
| CONF-9107179– | | (European workshop on ordering and disordering; Grenoble (France); 10-12 Jul 1991) | | | |
| 1 | 16:34543 | *See* LBL–31086 | | | |
| CONF-910728– | | (32. US symposium on rock mechanics; Norman, OK (United States); 10-12 Jul 1991) | | | |
| 5 | 16:33779 | *See* SAND–90-2081 | | | |
| 6 | 16:33780 | *See* SAND–90-2367 | | | |
| CONF-910730– | | (4. international conference on synchrotron radiation instrumentation; Chester (United Kingdom); 15-19 Jul 1991) | | | |
| 14 | 16:34887 | *See* BNL–46592 | | | |
| 15 | 16:34903 | *See* LBL–30459 | | | |
| CONF-910739– | | (ASME/AIChE/ANS national heat transfer conference; Minneapolis, MN (United States); 26-31 Jul 1991) | | | |
| 28 | 16:35054 | *See* EGG-M–90460 | | | |
| CONF-910762– | | (8. conference on the computation of electromagnetic fields; Sorrento (Italy); 7-11 Jul 1991) | | | |
| 1 | 16:34878 | *See* LBL–29826 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-910774– | | (32. Institute of Nuclear Materials Management (INMM) annual meeting; New Orleans, LA (United States); 26-31 Jul 1991) | | | |
| 83 | 16:33818 | *See* WHC-SA–1129 | | | |
| CONF-910786– | | (International symposium on hydromechanics and heat/mass transfer in microgravity; Kama River (USSR); 6-11 Jul 1991) | | | |
| 1 | 16:35180 | *See* LBL–31200 | | | |
| CONF-910799– | | (Workshop on parallel computation in chemistry; Willowbrook, IL (United States); 17-19 Jul 1991) | | | |
| 1 | 16:35529 | *See* UCRL-JC–108197 | | | |
| CONF-910801– | | (26. intersociety energy conversion engineering (IECE) conference; Boston, MA (United States); 3-9 Aug 1991) | | | |
| 23 | 16:33829 | *See* UCRL-JC–105761 | | | |
| CONF-910809– | | (International symposium on energy and environment; Espoo (Finland); 25-28 Aug 1991) | | | |
| 3 | 16:34344 | *See* PNL-SA–19657 | | | |
| CONF-9108105– | | (8. topical conference on atomic processes in plasmas; Portland, ME (United States); 25-29 Aug 1991) | | | |
| 1 | 16:35171 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000735 | MF-420 |
| CONF-9108114– | | (2. international symposium on chemistry in high temperature water; Provo, UT (United States); 19-22 Aug 1991) | | | |
| 2 | 16:34602 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017695 | MF-401 |
| CONF-9108115– | | (1991 Society of Automotive Engineers (SAE) future transportation technology conference; Portland, OR (United States); 5-8 Aug 1991) | | | |
| 2 | 16:34350 | *See* ANL/CP–73909 | | | |
| CONF-9108118– | | (13. international free-electron laser (FEL) conference; Santa Fe, NM (United States); 25-30 Aug 1991) | | | |
| 3 | 16:34848 | *See* LA-UR–91-3013 | | | |
| 4 | 16:34897 | *See* LA-UR–91-3092 | | | |
| 5 | 16:34862 | *See* LA-UR–91-3091 | | | |
| 6 | 16:34899 | *See* LA-UR–91-3112 | | | |
| 7 | 16:34871 | *See* BNL–46582 | | | |
| 8 | 16:34872 | *See* BNL–46608 | | | |
| 9 | 16:34907 | *See* LBL–31196 | | | |
| 10 | 16:34908 | *See* LBL–31197 | | | |
| 11 | 16:34906 | *See* LBL–31195 | | | |
| 12 | 16:34881 | *See* LBL–31198 | | | |
| CONF-910812– | | (202. national meeting of the American Chemical Society (ACS); New York, NY (United States); 25-30 Aug 1991) | | | |
| 12 | 16:34409 | *See* BNL–46477 | | | |
| CONF-9108122– | | (14. International Council of the Aeronautical Sciences (ICAS) conference; Garmisch-Partenkirchen (Germany); 19-23 Aug 1991) | | | |
| 2 | 16:34570 | *See* SAND–91-0648C | | | |
| CONF-9108141– | | (International cosmic ray conference; Dublin (Ireland); 11-23 Aug 1991) | | | |
| 2-Exc. | 16:35166 | *See* LA-UR–91-2911 | | | |
| CONF-9108142– | | (Recent progress in many-body theories; Minneapolis, MN (United States); 26-31 Aug 1991) | | | |
| 2 | 16:35289 | *See* ANL/CP–74237 | | | |
| 3 | 16:35242 | *See* LA-UR–91-3023 | | | |
| CONF-9108145– | | (11. post structural mechanics in reactor technology (SMIRT) conference; Nara (Japan); 26-28 Aug 1991) | | | |
| 1 | 16:34114 | *See* ANL/CP–73995 | | | |
| CONF-9108150– | | (9. international conference on positron annihilation; Szombathely (Hungary); 26-31 Aug 1991) | | | |
| 2 | 16:35357 | *See* UCRL-JC–106988 | | | |
| CONF-9108153– | | (1991 scanning tunneling microscopy; Interlaken (Switzerland); 12-16 Aug 1991) | | | |
| 1 | 16:34955 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018174 | MF-408 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9108154– | | (American Glovebox Society annual conference and equipment show; Nashville, TN (United States); 26-29 Aug 1991) | | | |
| 1 | 16:33814 | *See* LA-UR–91-2790 | | | |
| CONF-9108156– | | (American Chemical Society (ACS) meeting; Salt Lake City, UT (United States); 19-22 Aug 1991) | | | |
| 1 | 16:34576 | *See* SAND–91-1883C | | | |
| CONF-9108157– | | (Annual meeting of the boiling water reactors (BWR) owner's group; Seattle, WA (United States); 1-2 Aug 1991) | | | |
| 1 | 16:34116 | *See* BNL-NUREG–46542 | | | |
| CONF-9108159– | | (Department of Energy-Office of Health and Environmental Research (DOE-OHER) radon contractors' meeting; Albuquerque, NM (United States); 23-25 Aug 1991) | | | |
| 1 | 16:35025 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018938 | MF-407 |
| CONF-9108160– | | (38. international field emission symposium; Vienna (Austria); 5-9 Aug 1991) | | | |
| 1 | 16:34962 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018926 | MF-406 |
| CONF-9108162– | | (Department of Energy (DOE) radiation protection conference; Knoxville, TN (United States); 27-29 Aug 1991) | | | |
| 2 | 16:35013 | *See* LA-UR–91-2957 | | | |
| 3 | 16:34946 | *See* PNL-SA–19841 | | | |
| CONF-9108163– | | (2. pollution prevention conference; Pittsburg, PA (United States); 20-21 Aug 1991) | | | |
| 1 | 16:34404 | *See* PNL-SA–19624 | | | |
| CONF-9108164– | | (Chemistry and physics of liquids conference; Plymouth, NH (United States); 12-16 Aug 1991) | | | |
| 1 | 16:35181 | *See* PNL-SA–19765 | | | |
| CONF-9108166– | | (National Military Fish and Wildlife Association (NMFWA) meeting; Colorado Springs, CO (United States); 16 Aug 1991) | | | |
| 1 | 16:35098 | *See* EGG–10617-2094 | | | |
| CONF-9108167– | | (Annual LAMPF users meeting; Los Alamos, NM (United States); 19-20 Aug 1991) | | | |
| 1 | 16:35255 | *See* BNL–46573 | | | |
| CONF-9108168– | | (Optical probes of conjugated polymers conference; Snowbird, UT (United States); 19-22 Aug 1991) | | | |
| 1 | 16:34565 | *See* LA-UR–91-2862 | | | |
| CONF-9108169– | | (International Energy Agency (IEA) workshop on ground-source heat pumps; Montreal (Canada); 12-13 Aug 1991) | | | |
| 1 | 16:34368 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000420 | MF-350 |
| CONF-9108172– | | (Surface Mount International (SMI) conference; San Jose, CA (United States); 27-29 Aug 1991) | | | |
| 2 | 16:34509 | *See* LBL–31074 | | | |
| CONF-910831– | | (15. biennial conference on reactor operating experience: international conference on nuclear power plant operations; Bellevue, WA (United States); 11-14 Aug 1991) | | | |
| 8 | 16:33987 | *See* EGG-M–91047 | | | |
| CONF-910852– | | (Summer national meeting of the American Institute of Chemical Engineers (AIChE); Pittsburgh, PA (United States); 20-22 Aug 1991) | | | |
| 15 | 16:33791 | *See* UCRL-JC–105665 | | | |
| 3-Extd.Abst. | 16:33725 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017693 | MF-526 |
| CONF-910855– | | (NATO Advanced Study Institute on surfaces and interfaces; Neos Marmaras (Greece); 18-30 Aug 1991) | | | |
| 1 | 16:34524 | *See* ANL/CP–73957 | | | |
| CONF-910860– | | (NATO Advanced Study Institute on physics and materials science of high-temperature superconductors; Corfu Island (Greece); 18-31 Aug 1991) | | | |
| 2 | 16:34526 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018858 | MF-404 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **CONF-910862–** | | (Pacific-international congress on x-ray analytical methods; Honolulu, HI (United States); 12-16 Aug 1991) | | | |
| 4 | 16:34597 | *See* PNL-SA–19812 | | | |
| **CONF-910864–** | | (4. international conference on hadron spectroscopy; College Park, MD (United States); 12-16 Aug 1991) | | | |
| 1 | 16:35230 | *See* ORNL/CCIP–91/25 | | | |
| **CONF-910867–** | | (10. international symposium on plasma chemistry; Jerusalem (Israel); 4-9 Aug 1991) | | | |
| 1 | 16:35179 | *See* EGG-M–91257 | | | |
| **CONF-910869–** | | (9. topical conference on radio frequency power in plasmas; Charleston, SC (United States); 12-14 Aug 1991) | | | |
| 5 | 16:35377 | *See* ANL/CP–73548 | | | |
| 6 | 16:35441 | *See* GA-A–20627 | | | |
| 7 | 16:35415 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018930 | MF-421 |
| 9 | 16:35416 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018865 | MF-420 |
| 10 | 16:35379 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018845 | MF-420 |
| 11 | 16:35417 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000065 | MF-421 |
| 12 | 16:35418 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000050 | MF-422 |
| 13 | 16:35380 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000048 | MF-420 |
| 14 | 16:35381 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000741 | MF-421 |
| **CONF-910874–** | | (7. international conference on the physics of non-crystalline solids; Cambridge, MA (United States); 4-9 Aug 1991) | | | |
| 2 | 16:34549 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000077 | MF-404 |
| **CONF-910881–** | | (Particles and fields '91; Vancouver (Canada); 18-22 Aug 1991) | | | |
| 7 | 16:35201 | *See* FNAL/C–91/223-E | | | |
| 8 | 16:34868 | *See* SLAC-PUB–5651 | | | |
| 9 | 16:35202 | *See* FNAL/C–91/227 | | | |
| 10 | 16:35229 | *See* LA-UR–91-3038 | | | |
| 11 | 16:35187 | *See* ANL-HEP-CP–91-76 | | | |
| 12 | 16:35372 | *See* LA-UR–91-2888 | | | |
| 13 | 16:35192 | *See* BNL–46517 | | | |
| 14 | 16:35228 | *See* FNAL/C–91/225 | | | |
| 15 | 16:35204 | *See* FNAL/C–91/236-E | | | |
| 16 | 16:35191 | *See* BNL–46214 | | | |
| 17 | 16:35203 | *See* FNAL/C–91/234-E | | | |
| 18 | 16:35205 | *See* FNAL/C–91/237-E | | | |
| **CONF-910901–** | | (4. international conference on facility operations/safeguards interface; Albuquerque, NM (United States); 29 Sep - 4 oct 1991) | | | |
| 6 | 16:34797 | *See* RFP–4459 | | | |
| 7 | 16:33811 | *See* ANL/CP–72005 | | | |
| 9 | 16:33816 | *See* LA-UR–91-3081 | | | |
| 13 | 16:33815 | *See* LA-UR–91-2879 | | | |
| **CONF-910902–** | | (1991 international conference on coal science; Newcastle upon Tyne (United Kingdom); 16-20 Sep 1991) | | | |
| 7 | 16:33589 | *See* ANL/CP–73182 | | | |
| **CONF-910909–** | | (1. international conference on heat-resistant materials; Lake Geneva, WI (United States); 22-26 Sep 1991) | | | |
| 10 | 16:33618 | *See* ANL/CP–72920 | | | |
| 11 | 16:33965 | *See* ANL/CP–72862 | | | |
| **CONF-9109102–** | | (5. annual conference on superconductivity and applications; Buffalo, NY (United States); 24-26 Sep 1991) | | | |
| 1 | 16:34527 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000423 | MF-404 |
| **CONF-9109103–** | | (5. international conference on the structure of non-crystalline materials; Sendai (Japan); 2-6 Sep 1991) | | | |
| 1 | 16:35350 | *See* LA-UR–91-2968 | | | |
| 3 | 16:34548 | *See* ANL/CP–73443 | | | |
| **CONF-9109110–** | | (International conference on frontiers in innovative computing for the nuclear industry; Jackson, WY (United States); 15-18 Sep 1991) | | | |
| 8 | 16:34979 | *See* LA-UR–91-2971 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9109114– | | (6. symposium on containment of underground nuclear explosions; Reno, NV (United States); 24-26 Sep 1991) | | | |
| Absts. | 16:34981 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018719 | MF-742 |
| CONF-9109121– | | (Symposium on expert system applications for the electric power industry; Boston, MA (United States); 9-11 Sep 1991) | | | |
| 3 | 16:34779 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018860 | |
| 4 | 16:35501 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018857 | MF-405 |
| CONF-9109122– | | (13. European conference on few-body problems in physics; Elba (Italy); 9-14 Sep 1991) | | | |
| -2 | 16:35310 | *See* LA-UR–91-2922 | | | |
| CONF-9109134– | | (34. annual meeting of the Association of Engineering Geologists: environmental and geotechnical challenges for the decade; Chicago, IL (United States); 30 Sep - 4 oct 1991) | | | |
| 1 | 16:35024 | *See* ANL/CP–73676 | | | |
| CONF-9109162– | | (Industrial Gas Cleaning Institute forum '91; Washington, DC (United States); 11-13 Sep 1991) | | | |
| 1 | 16:33976 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000287 | MF-105 |
| CONF-9109176– | | (Annual congress of the European Association of Nuclear Medicine; Vienna (Austria); 1-5 Sep 1991) | | | |
| 1 | 16:33821 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018853 | MF-407 |
| CONF-910920– | | (4. topical meeting on tritium technology in fission, fusion, and isotopic applications; Albuquerque, NM (United States); 30 Sep - 4 oct 1991) | | | |
| 2 | 16:35026 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018937 | MF-402 |
| 3 | 16:34578 | *See* SAND–91-2014C | | | |
| 4 | 16:35454 | *See* LA-UR–91-3017 | | | |
| 5 | 16:35457 | *See* LA-UR–91-3114 | | | |
| CONF-9109200– | | (International workshop on fast wave current drive in reactor scale tokamaks synergy and complementarity with LHCD and ECRH; Cadarache (France); 23-25 Sep 1991) | | | |
| 1 | 16:35382 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000076 | MF-420 |
| CONF-9109208– | | (International symposium on gallium arsenide and related compounds; Seattle, WA (United States); 23-26 Sep 1991) | | | |
| 4 | 16:34572 | *See* SAND–91-0995C | | | |
| CONF-9109211– | | (Direct liquefaction contractors' review meeting; Pittsburgh, PA (United States); 3-5 Sep 1991) | | | |
| 3 | 16:33588 | *See* SAND–91-7081C | | | |
| CONF-9109226– | | (AIAA/NASA/OAI conference on advanced SEI technologies; Cleveland, OH (United States); 3-4 Sep 1991) | | | |
| 12 | 16:34419 | *See* LA-UR–91-2800 | | | |
| 14 | 16:34112 | *See* SAND–91-1987C | | | |
| 15 | 16:34243 | *See* EGG-M–91113 | | | |
| 16 | 16:34027 | *See* PNL-SA–19728 | | | |
| 17 | 16:34214 | *See* PNL-SA–19771 | | | |
| CONF-9109232– | | (RADECS 91: radiation effects on components and systems; Montpellier (France); 9-12 Sep 1991) | | | |
| 2 | 16:34951 | *See* SAND–89-0167C | | | |
| CONF-9109234– | | (4. Tennessee water resources symposium; Knoxville, TN (United States); 24-26 Sep 1991) | | | |
| 6 | 16:35027 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000067 | MF-902; MF-940 |
| CONF-9109247– | | (Society of Manufacturing Engineers (SME) electric discharge machining (EDM) clinic; Grand Rapids, MI (United States); 17 Sep 1991) | | | |
| 1 | 16:34514 | *See* RFP–4498 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9109253– | | (Joint EPA and Air and Waste Management Association (AWMA), air inventory issues of the 1990's; Durham, NC (United States); 11 Sep 1991) | | | |
| 1 | 16:35018 | *See* RFP–4451 | | | |
| CONF-9109254– | | (Solar connection with transient interplanetary processes (SOLTIP); Castle Liblice (Czechoslovakia); 30 Sep - 5 oct 1991) | | | |
| 2 | 16:35167 | *See* LA-UR–91-2945 | | | |
| CONF-9109255– | | (Challenge of the environment: new technologies; Restono, VA (United States); 5-6 Sep 1991) | | | |
| 1 | 16:33899 | *See* SERI/TP–250-4474 | | | |
| CONF-9109259– | | (1. international congress on environmentally conscious manufacturing; Santa Fe, NM (United States); 18 Sep 1991) | | | |
| 1 | 16:34516 | *See* SAND–91-1509C | | | |
| 2 | 16:35492 | *See* SAND–91-2090C | | | |
| 3 | 16:34406 | *See* SAND–91-1940C | | | |
| 5 | 16:34397 | *See* LA-UR–91-2991 | | | |
| 6 | 16:34398 | *See* LA-UR–91-3028 | | | |
| 7 | 16:34846 | *See* KCP–613-4673 | | | |
| 9 | 16:34802 | *See* SAND–91-1620C | | | |
| CONF-9109261– | | (3. OECD/NEA workshop: near-field effects of gas release; Aix-en-Provence (France); 23-26 Sep 1991) | | | |
| 2 | 16:33787 | *See* SAND–91-1872C | | | |
| 4 | 16:33777 | *See* SAND–90-0707C | | | |
| CONF-9109264– | | (1991 CREARE.X software users meeting; Burlington, VT (United States); 17-19 Sep 1991) | | | |
| 1 | 16:34831 | *See* SAND–91-0828C | | | |
| CONF-9109265– | | (Toxicity and carcinogenicity of cadmium in the human environment international symposium; Gargnano (Italy); 25-27 Sep 1991) | | | |
| 1 | 16:35128 | *See* ANL/CP–72578 | | | |
| CONF-9109266– | | (International Atomic Energy Agency (IAEA) specialists meeting on status of graphite development for gas-cooled reactors; Tokai (Japan); 9-12 Sep 1991) | | | |
| 1 | 16:34011 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000056 | MF-522 |
| 2 | 16:34012 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018868 | MF-504; MF-522 |
| CONF-9109267– | | (International conference on multiphase flows; Tsukuba (Japan); 24-27 Sep 1991) | | | |
| 1 | 16:35176 | *See* DOE/ER/13764–9 | | | |
| CONF-9109268– | | (OECD/NEA workshop on long-term observation of the geological environment: needs and techniques; Helsinki (Finland); 9-11 Sep 1991) | | | |
| 1 | 16:33786 | *See* SAND–91-1738C | | | |
| CONF-9109271– | | (3. Committee for the Safety of Nuclear Installations (CSNI) workshop on iodine chemistry in reactor safety; Tokai-mura (Japan); 11-13 Sep 1991) | | | |
| 1 | 16:34054 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018854 | |
| CONF-9109272– | | (Annual meeting of doctors for defense preparedness; Las Vegas, NV (United States); 22 Sep 1991) | | | |
| 1 | 16:34985 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018932 | MF-400 |
| CONF-9109273– | | (American Civil Defense Association (ACDA) annual meeting; Las Vegas, NV (United States); 25 Sep 1991) | | | |
| 1 | 16:34986 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018931 | MF-400 |
| CONF-9109274– | | (ECM '91 congress; Santa Fe, NM (United States); 18-20 Sep 1991) | | | |
| 1 | 16:34405 | *See* SAND–91-1894C | | | |
| CONF-9109276– | | (Cray users group conference; Santa Fe, NM (United States); 23-27 Sep 1991) | | | |
| 1 | 16:35525 | *See* SAND–91-2116C | | | |
| 2 | 16:35509 | *See* LA-UR–91-2924 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 3 | 16:35524 | *See* SAND–91-2115C | | | |
| CONF-9109278– | | (International Joliot-Curie summer school of nuclear physics; Maubuissen (France); 16-21 Sep 1991) | | | |
| 1 | 16:35281 | *See* ANL/CP–72878 | | | |
| CONF-9109279– | | (International school of plasma physics high power microwave generation and applications; Varenna (Italy); 9-17 Sep 1991) | | | |
| 1 | 16:34895 | *See* LA-UR–91-2834 | | | |
| 2 | 16:34847 | *See* LA-UR–91-2833 | | | |
| CONF-9109280– | | (2. annual CLIPS conference; Houston, TX (United States); 23-25 Sep 1991) | | | |
| 1-Draft | 16:33820 | *See* LA-UR–91-2887 | | | |
| CONF-9109281– | | (Aerotech '91 Society of Automotive Engineers (SAE) conference; Long Beach, CA (United States); 23 Sep 1991) | | | |
| 1 | 16:34436 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018855 | MF-310 |
| CONF-9109284– | | (4. international symposium on genetic aspects of plant mineral nutrition; Canberra (Australia); 30 Sep - 4 oct 1991) | | | |
| 1 | 16:35096 | *See* LA-UR–91-3050 | | | |
| CONF-9109285– | | (5. international symposium on materials in space environment; Cannes (France); 16-20 Sep 1991) | | | |
| 1 | 16:34835 | *See* LA-UR–91-3052 | | | |
| CONF-9109286– | | (European Materials Research Society (E-MRS) summer school on laser ablation of electronic materials: basic mechanisms and applications; Carcans-Maubuisson (France); 16-19 Sep 1991) | | | |
| 1 | 16:34528 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000447 | MF-404 |
| 2 | 16:34437 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000431 | MF-421 |
| CONF-9109287– | | (4. international symposium on the synthesis and applications of isotopes and isotopically labeled compounds; Toronto (Canada); 3 Sep 1991) | | | |
| 1 | 16:34763 | *See* BNL–46589 | | | |
| CONF-9109290– | | (Aircraft design meeting; Baltimore, MD (United States); 23-25 Sep 1991) | | | |
| 1 | 16:35015 | *See* LBL–31118 | | | |
| CONF-9109291– | | (5. mesons and light nuclei; Prague (Czechoslovakia); 1-6 Sep 1991) | | | |
| 1 | 16:35305 | *See* DOE/ER/40537–9 | | | |
| CONF-910938– | | (International conference on high temperature aluminides and intermetallics; San Diego, CA (United States); 17-19 Sep 1991) | | | |
| 2 | 16:34503 | *See* LA-UR–91-3051 | | | |
| 3 | 16:34435 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000432 | MF-310 |
| CONF-910943– | | (4. international conference on ion sources; Bensheim (Germany); 30 Sep - 4 oct 1991) | | | |
| 2 | 16:34886 | *See* BNL–45962 | | | |
| CONF-910952– | | (Fall conference and 50th anniversary conference of the American Society for Nondestructive Testing; Boston, MA (United States); 15-18 Sep 1991) | | | |
| 1 | 16:35312 | *See* SAND–91-2113C | | | |
| CONF-910968– | | (14. IEEE symposium on fusion engineering; San Diego, CA (United States); 30 Sep - 3 oct 1991) | | | |
| 2 | 16:35419 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000073 | MF-420 |
| 3 | 16:35459 | *See* LA-UR–91-3130 | | | |
| 4 | 16:35458 | *See* LA-UR–91-3115 | | | |
| 5 | 16:35392 | *See* GA-A–20614 | | | |
| 6 | 16:35440 | *See* GA-A–20624 | | | |
| 7 | 16:35420 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000426 | MF-421 |
| 8 | 16:35421 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000430 | MF-426 |
| 10 | 16:35422 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000740 | MF-422 |
| 11 | 16:35423 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000729 | MF-420 |
| 12 | 16:35424 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000742 | MF-420 |
| 13 | 16:35425 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000731 | MF-420 |
| 14 | 16:35426 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000672 | MF-420 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 15 | 16:35427 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000681 | MF-420 |
| 16 | 16:35428 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000736 | MF-420 |
| 17 | 16:35429 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000737 | MF-420 |
| 18 | 16:35430 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000739 | MF-423 |
| 19 | 16:35431 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92001679 | MF-424 |
| **CONF-910981–** | | (Environmental remediation '91 conference; Pasco, WA (United States); 8-11 Sep 1991) | | | |
| 6 | 16:33756 | *See* FMPC–2227 | | | |
| 7 | 16:33806 | *See* FMPC–2222 | | | |
| 9 | 16:35073 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000063 | MF-902 |
| 12 | 16:35074 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000064 | MF-402 |
| 13 | 16:33758 | *See* FMPC–2240 | | | |
| 14 | 16:33757 | *See* FMPC–2238 | | | |
| 15 | 16:33773 | *See* PNL-SA–19908 | | | |
| 16 | 16:33819 | *See* PNL-SA–19894 | | | |
| 17 | 16:35065 | *See* PNL-SA–19469 | | | |
| 20 | 16:35023 | *See* ANL/CP–72961 | | | |
| 21 | 16:33799 | *See* ANL/CP–74208 | | | |
| 25 | 16:35083 | *See* PNL-SA–19646 | | | |
| **CONF-910993–** | | (International conference on nuclear criticality (ICNC) safety; Oxford (United Kingdom); 9-13 Sep 1991) | | | |
| 15 | 16:34113 | *See* ANL/CP–73482 | | | |
| 16 | 16:34037 | *See* EGG-M–90534 | | | |
| **CONF-911001–** | | (International conference on fast reactor systems and fuel cycles; Kyoto (Japan); 27 Oct - 1 nov 1991) | | | |
| 6 | 16:34025 | *See* WHC-SA–1073 | | | |
| 9 | 16:34211 | *See* WHC-SA–1074 | | | |
| 10 | 16:34026 | *See* WHC-SA–1088 | | | |
| 22 | 16:34020 | *See* ANL/CP–73941 | | | |
| 23 | 16:34018 | *See* ANL/CP–72183 | | | |
| 3-Rev. | 16:34115 | *See* BNL-NUREG–46511-Rev. | | | |
| **CONF-911003–** | | (Fall meeting of the Minerals, Metals and Materials Society of AIME and Materials Week of the American Society of Metals; Cincinnati, OH (United States); 20-24 Oct 1991) | | | |
| 12 | 16:34517 | *See* SAND–91-1843C | | | |
| 15 | 16:34803 | *See* SAND–91-1756C | | | |
| 16 | 16:34853 | *See* SAND–91-2078C | | | |
| **CONF-911004–** | | (3. conference on radiation protection and dosimetry; Orlando, FL (United States); 21-24 Oct 1991) | | | |
| 2 | 16:34931 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018842 | MF-606 |
| **CONF-911011–** | | (International workshop on radium, uranium, thorium and related nuclides in industry and medicine: history and current use; Badgastein (Austria); 1-3 Oct 1991) | | | |
| 1 | 16:35109 | *See* ANL/CP–74386 | | | |
| **CONF-9110117–** | | (2. international conference on uranium hexafluoride handling; Oak Ridge, TN (United States); 29-31 Oct 1991) | | | |
| 2 | 16:34795 | *See* POEF-T–3569 | | | |
| 3 | 16:33733 | *See* POEF-T–3567 | | | |
| 4 | 16:33732 | *See* POEF-T–3566 | | | |
| 5 | 16:33722 | *See* POEF-T–3565 | | | |
| 6 | 16:34796 | *See* POEF-T–3574 | | | |
| **CONF-9110122–** | | (Natural phenomena hazards mitigation conference; St. Louis, MO (United States); 15-18 Oct 1991) | | | |
| 6 | 16:33812 | *See* BNL–46540 | | | |
| 7 | 16:35143 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000068 | MF-403 |
| 10 | 16:34833 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000074 | MF-706 |
| **CONF-911014–** | | (International conference on dynamics and control in nuclear power stations; London (United Kingdom); 22-24 Oct 1991) | | | |
| 1 | 16:34060 | *See* ANL/CP–71328 | | | |
| **CONF-9110149–** | | (66. annual Society of Petroleum Engineers (SPE) technical conference and exhibition; Dallas, TX (United States); 6-9 Oct 1991) | | | |
| 3 | 16:33660 | *See* EGG-M–91102 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-9110168– | | (Department of Energy model conference; Oak Ridge, TN (United States); 14-17 Oct 1991) | | | |
| 1 | 16:33785 | *See* SAND–91-1021C | | | |
| 2 | 16:33784 | *See* SAND–91-0913C | | | |
| 3 | 16:33769 | *See* LA-UR–91-3014 | | | |
| CONF-9110172– | | (17. DOE compatibility and aging and service life conference; Golden, CO (United States); 1-3 Oct 1991) | | | |
| 4 | 16:34978 | *See* UCRL-JC–108312 | | | |
| CONF-9110195– | | (American Nuclear Society (ANS) conference; Albuquerque, NM (United States); 4 Oct 1991) | | | |
| 2 | 16:33768 | *See* LA-UR–91-2765 | | | |
| CONF-9110207– | | (HazMat South '91 (Hazardous materials management conference); Atlanta, GA (United States); 2-4 Oct 1991) | | | |
| 1 | 16:33734 | *See* ANL/CP–73026 | | | |
| CONF-9110211– | | (1991 international test conference; Nashville, TN (United States); 28 Oct - 1 nov 1991) | | | |
| 1 | 16:34851 | *See* SAND–91-1726C | | | |
| CONF-9110212– | | (1991 American Society of Mechanical Engineers (ASME) annual meeting; San Diego, CA (United States); 7 Oct 1991) | | | |
| 1 | 16:34019 | *See* ANL/CP–73345 | | | |
| CONF-9110214– | | (US/Japan joint seminar on heat transfer; Oiso (Japan); 21-25 Oct 1991) | | | |
| 1 | 16:33911 | *See* SAND–91-1694C | | | |
| CONF-9110216– | | (1991 applied geography conference; Toledo, OH (United States); 23-27 Oct 1991) | | | |
| 1 | 16:34410 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000049 | MF-402 |
| CONF-9110217– | | (42. International Aeronautical Federation Congress (IAEFC); Montreal (Canada); 7-11 Oct 1991) | | | |
| 1 | 16:34247 | *See* EGG-M–91352 | | | |
| 2 | 16:34111 | *See* LA-UR–91-3100 | | | |
| CONF-9110218– | | (Oceans '91; Honolulu, HI (United States); 1-3 Oct 1991) | | | |
| 1 | 16:33864 | *See* ANL/CP–72704 | | | |
| CONF-9110219– | | (ONC/Network File System (NFS) industry networking conference; Santa Clara, CA (United States); 6-8 Oct 1991) | | | |
| 1 | 16:35508 | *See* LA-UR–91-2923 | | | |
| CONF-9110221– | | (RF Expo '91; Orlando, FL (United States); 29 Oct 1991) | | | |
| 1 | 16:34898 | *See* LA-UR–91-3102 | | | |
| CONF-9110223– | | (Mixed waste regulation; Albuquerque, NM (United States); 2-3 Oct 1991) | | | |
| 1 | 16:34251 | *See* LA-UR–91-3058 | | | |
| CONF-9110225– | | (1991 symposium on the Superconducting Super Collider (SSC); Corpus Christi, TX (United States); 13-17 Oct 1991) | | | |
| 1 | 16:34883 | *See* SSCL–507 | | | |
| CONF-9110226– | | (7. annual North American welding research (NAWR) conference; Columbus, OH (United States); 2-4 Oct 1991) | | | |
| 1 | 16:34440 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000428 | MF-404 |
| CONF-9110228– | | (13. AIRAPT international conference on high pressure science and technology; Bangalore (India); 7-11 Oct 1991) | | | |
| 2 | 16:34837 | *See* SAND–91-1374C | | | |
| CONF-9110231– | | (Topical conference on nuclear data for fusion reactor technology; Karlsruhe (Germany); 23 Oct 1991) | | | |
| 1 | 16:35432 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000435 | MF-413 |
| CONF-9110235– | | (Intelligence community modeling group; Ann Arbor, MI (United States); 15-19 Oct 1991) | | | |
| 1 | 16:35526 | *See* SAND–91-2257C | | | |
| CONF-911029– | | (7. symposium on neutron dosimetry; Berlin (Germany); 14-18 Oct 1991) | | | |
| 1 | 16:34947 | *See* SLAC-PUB–5655 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-911041– | | (8. annual international Pittsburgh coal conference: coal - energy and the environment; Pittsburgh, PA (United States); 14-18 Oct 1991) | | | |
| 2 | 16:33587 | *See* SAND–91-1637C | | | |
| 3 | 16:33547 | *See* BNL–46562 | | | |
| CONF-911047– | | (180. meeting of the Electrochemical Society; Phoenix, AZ (United States); 13-18 Oct 1991) | | | |
| 7 | 16:34223 | *See* ANL/CP–73233 | | | |
| CONF-911048– | | (American Society for Testing and Materials (ASTM) symposium on thermo-mechanical fatigue: behavior of materials; San Diego, CA (United States); 14-17 Oct 1991) | | | |
| 1 | 16:34438 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018863 | |
| 2 | 16:34439 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018851 | MF-404 |
| CONF-911071– | | (American Chemical Society symposium on emerging technologies for hazardous waste management; Atlanta, GA (United States); 1-3 Oct 1991) | | | |
| 4 | 16:33735 | *See* BNL–46359 | | | |
| CONF-911084– | | (International symposium on ceramics; Yokohama (Japan); 16-18 Oct 1991) | | | |
| 3 | 16:34522 | *See* ANL/CP–72064 | | | |
| CONF-911088– | | (52. international water conference; Pittsburgh, PA (United States); 21-23 Oct 1991) | | | |
| 1 | 16:34603 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017875 | |
| CONF-911107– | | (Winter meeting of the American Nuclear Society (ANS); San Francisco, CA (United States); 10-15 Nov 1991) | | | |
| 31 | 16:33985 | *See* UCRL-JC–107642 | | | |
| CONF-9111100– | | (1991 cruise missiles technology symposium (CMTS); Laurel, MD (United States); 7 Nov 1991) | | | |
| 1 | 16:34973 | *See* SAND–91-2189C | | | |
| CONF-911111– | | (International conference on fusion reactor materials; Clearwater, FL (United States); 17-22 Nov 1991) | | | |
| 1 | 16:35456 | *See* LA-UR–91-3029 | | | |
| 2 | 16:35433 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92001681 | MF-423 |
| CONF-911115– | | (17. international symposium for testing and failure analysis; Los Angeles, CA (United States); 11-15 Nov 1991) | | | |
| 2 | 16:34850 | *See* SAND–91-0741C | | | |
| CONF-911125– | | (3. international reservoir characterization technical conference; Tulsa, OK (United States); 3-5 Nov 1991) | | | |
| 1 | 16:33654 | *See* SAND–91-0980C | | | |
| CONF-911133– | | (American Institute of Chemical Engineers (AIChE) annual meeting; Los Angeles, CA (United States); 17-22 Nov 1991) | | | |
| 2 | 16:33619 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018935 | MF-103 |
| CONF-911185– | | (Conference and exposition on petroleum hydrocarbons and organic chemicals in ground water: prevention, detection and restoration; Houston, TX (United States); 20-22 Nov 1991) | | | |
| 1 | 16:35087 | *See* UCRL-JC–108064 | | | |
| CONF-911187– | | (International telemetering conference; Las Vegas, NV (United States); 4 Nov 1991) | | | |
| 1 | 16:33964 | *See* SERI/TP–257-4123 | | | |
| 2 | 16:35506 | *See* KCP–613-4624 | | | |
| CONF-911195– | | (Army symposium on solid mechanics: synergism of mechanics, mathematics and materials; Plymouth, MA (United States); 4-7 Nov 1991) | | | |
| 1 | 16:34977 | *See* SAND–91-0364C | | | |
| CONF-911196– | | (10. international congress on applications of lasers and electro-optics (ICALEO) conference; San Jose, CA (United States); 3-8 Nov 1991) | | | |
| 1 | 16:34441 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018934 | MF-404 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| CONF-911197– | | (Electroless nickel '91; Orlando, FL (United States); 20-22 Nov 1991) | | | |
| 1 | 16:34518 | *See* UCRL-JC–107839 | | | |
| CONF-911198– | | (5. international gun propellant and propulsion symposium; Dover, NJ (United States); 19-21 Nov 1991) | | | |
| 1 | 16:34577 | *See* SAND–91-1992C | | | |
| CONF-911202– | | (Annual fall meeting of the Materials Research Society; Boston, MA (United States); 2-6 Dec 1991) | | | |
| 1 | 16:34542 | *See* LBL–30948 | | | |
| CONF-911209– | | (Faraday symposium no. 27: the conformations of flexible molecules in fluid phases; Southampton (United Kingdom); 16-18 Dec 1991) | | | |
| 1 | 16:34575 | *See* SAND–91-1847C | | | |
| CONF-911213– | | (American Society of Mechanical Engineers (ASME) annual winter meeting; Atlanta, GA (United States); 1-6 Dec 1991) | | | |
| 1 | 16:34571 | *See* SAND–91-0653C | | | |
| 2 | 16:34780 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91013234 | MF-900 |
| 3 | 16:34823 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91014212 | MF-310 |
| 4 | 16:34824 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91015633 | MF-350 |
| 5 | 16:34427 | *See* LA-UR–91-2473 | | | |
| 6 | 16:34442 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91017690 | |
| 7 | 16:34352 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017948 | MF-330 |
| 8 | 16:34502 | *See* LA-UR–91-2703 | | | |
| 9 | 16:34989 | *See* BNL–46550 | | | |
| 10 | 16:34566 | *See* LA-UR–91-2975 | | | |
| 11-Draft | 16:33788 | *See* SAND–91-7030C | | | |
| CONF-911224– | | (1991 winter simulation conference; Phoenix, AZ (United States); Dec 1991) | | | |
| 1 | 16:35507 | *See* LA-UR–91-1068 | | | |
| CONF-911225– | | (1991 American Society of Mechanical Engineers (ASME) winter meeting; Atlanta, GA (United States); 1-6 Dec 1991) | | | |
| 1 | 16:34500 | *See* LA-UR–91-1292 | | | |
| 2 | 16:34501 | *See* LA-UR–91-1852 | | | |
| CONF-911230– | | (3. Institute of Electrical and Electronic Engineers (IEEE) symposium on parallel and distributed processing; Dallas, TX (United States); 1 Dec 1991) | | | |
| 1 | 16:35521 | *See* SAND–91-1252C | | | |
| 2 | 16:35528 | *See* UCRL-JC–107491 | | | |
| CONF-911236– | | (Optical Society of America (OSA) conference on short wavelength coherent radiation; Monterey, CA (United States); Dec 1991) | | | |
| 1 | 16:35375 | *See* UCRL-JC–107319 | | | |
| CONF-911237– | | (7. Department of Energy workshop on CAE; Knoxville, TN (United States); 29 Dec 1991) | | | |
| 1 | 16:35491 | *See* SAND–91-1340C | | | |
| CONF-911240– | | (2. Japan international Society for the Advancement of Material and Process Engineering (SAMPE) symposium and exhibition; Chiba (Japan); 11-14 Dec 1991) | | | |
| 1 | 16:35434 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91016283 | MF-423 |
| 2 | 16:34443 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018253 | MF-404 |
| CONF-911241– | | (3. international machinery monitoring and diagnostic conference; Las Vegas, NV (United States); 9-12 Dec 1991) | | | |
| 1 | 16:34791 | *See* LA-UR–91-2284 | | | |
| 2 | 16:35371 | *See* LA-UR–91-2283 | | | |
| 3 | 16:34800 | *See* SAND–91-0491C | | | |
| CONF-911242– | | (POLYMET '91 conference and exhibition; Hong Kong (Hong Kong); 9-13 Dec 1991) | | | |
| 1 | 16:34316 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91016777 | MF-350 |
| CONF-911243– | | (15. international online meeting; London (United Kingdom); 10-12 Dec 1991) | | | |
| 1 | 16:35564 | *See* UCRL-JC–106995 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **CONF-911244–** | | (3. symposium on multiphase transport in porous media; Atlanta, GA (United States); 1-6 Dec 1991) | | | |
| 1 | 16:35070 | *See* WHC-SA–1289 | | | |
| **CONF-911246–** | | (Relevance of animal studies to evaluate human cancer risk conference; Austin, TX (United States); 5-8 Dec 1991) | | | |
| 1 | 16:35129 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017482 | MF-408 |
| 2 | 16:35130 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017483 | MF-408 |
| **CONF-911253–** | | (Semiconductor interface specialists conference; Orlando, FL (United States); 11-14 Dec 1991) | | | |
| 1 | 16:34852 | *See* SAND–91-1953C | | | |
| **CONF-911254–** | | (6. national symposium on onsite waste-water treatment; St. Joseph, MI (United States); 16-17 Dec 1991) | | | |
| 2 | 16:35028 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000045 | MF-402 |
| **CRIE-Y–** | | | | | |
| 90013 | 16:33983 | OSTI; NTIS (US Sales Only) | | DE92709574 | |
| **CWP–** | | | | | |
| 110 | 16:35144 | *See* DOE/ER/14079–10 | | | |
| **DESY–** | | | | | |
| 91-026 | 16:34932 | OSTI; NTIS (US Sales Only); INIS | | DE92704838 | |
| 91-035 | 16:35217 | OSTI; NTIS (US Sales Only); INIS | | DE92714309 | |
| 91-036 | 16:34920 | OSTI; NTIS (US Sales Only); INIS | | DE92714310 | |
| 91-037 | 16:35231 | OSTI; NTIS (US Sales Only); INIS | | DE92714304 | |
| 91-038 | 16:35362 | OSTI; NTIS (US Sales Only); INIS | | DE92714442 | |
| 91-039 | 16:35218 | OSTI; NTIS (US Sales Only); INIS | | DE92714305 | |
| 91-040 | 16:35235 | OSTI; NTIS (US Sales Only); INIS | | DE92714306 | |
| 91-041 | 16:35219 | OSTI; NTIS (US Sales Only); INIS | | DE92714430 | |
| 91-042 | 16:35236 | OSTI; NTIS (US Sales Only); INIS | | DE92714311 | |
| 91-043 | 16:35237 | OSTI; NTIS (US Sales Only); INIS | | DE92714431 | |
| 91-045 | 16:35220 | OSTI; NTIS (US Sales Only); INIS | | DE92714433 | |
| 91-047 | 16:34921 | OSTI; NTIS (US Sales Only); INIS | | DE92714440 | |
| 91-050 | 16:35221 | OSTI; NTIS (US Sales Only); INIS | | DE92714432 | |
| 91-051 | 16:35196 | OSTI; NTIS (US Sales Only); INIS | | DE92714438 | |
| 91-052 | 16:35238 | OSTI; NTIS (US Sales Only); INIS | | DE92714437 | |
| 91-053 | 16:35222 | OSTI; NTIS (US Sales Only); INIS | | DE92714435 | |
| 91-054 | 16:35223 | OSTI; NTIS (US Sales Only); INIS | | DE92714441 | |
| 91-055 | 16:35197 | OSTI; NTIS (US Sales Only); INIS | | DE92714436 | |
| 91-056 | 16:35198 | OSTI; NTIS (US Sales Only); INIS | | DE92714439 | |
| 91-058 | 16:35224 | OSTI; NTIS (US Sales Only); INIS | | DE92714443 | |
| 91-059 | 16:35225 | OSTI; NTIS (US Sales Only); INIS | | DE92714429 | |
| 91-060 | 16:35239 | OSTI; NTIS (US Sales Only); INIS | | DE92714428 | |
| 91-061 | 16:35226 | OSTI; NTIS (US Sales Only); INIS | | DE92714444 | |
| 91-062 | 16:35240 | OSTI; NTIS (US Sales Only); INIS | | DE92714445 | |
| **DESY-FH1T–** | | | | | |
| 91-01 | 16:34933 | OSTI; NTIS (US Sales Only); INIS | | DE92714333 | |
| **DISP-ARA-RAM–** | | | | | |
| 90-01 | 16:34995 | OSTI; NTIS (US Sales Only) | | DE92705883 | |
| **DOE/BC/10842–** | | | | | |
| 19 | 16:33656 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91002247 | PC-122 |
| **DOE/BC/14202–** | | | | | |
| 5 | 16:33657 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000276 | MF-122 |
| **DOE/BC/14434–** | | | | | |
| 4 | 16:33644 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000265 | MF-122 |
| **DOE/BC/14448–** | | | | | |
| 6 | 16:33645 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017217 | PC-122 |
| **DOE/BC/14473–** | | | | | |
| 6 | 16:33646 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000266 | MF-122 |
| **DOE/BC/14653–** | | | | | |
| 2 | 16:33647 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000274 | MF-122 |
| **DOE/BC/14658–** | | | | | |
| 3 | 16:33648 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000270 | MF-122 |
| **DOE/BC/14666–** | | | | | |
| 4 | 16:33649 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000267 | MF-122 |
| **DOE/BP–** | | | | | |
| 1418 | 16:34258 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000884 | MF-906; MF-920 |
| 1661 | 16:34259 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000885 | MF-920 |
| 1681 | 16:34219 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000887 | MF-902 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **DOE/BP/16480–** | | | | | |
| 5 | 16:33852 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000910 | MF-902 |
| **DOE/BP/63461–** | | | | | |
| 5 | 16:33853 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000912 | MF-902 |
| **DOE/CE–** | | | | | |
| 40762T-H2 | 16:34370 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000600 | MF-310 |
| **DOE/CE/15466–** | | | | | |
| T4 | 16:33613 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018431 | MF-310 |
| **DOE/CE/30844–** | | | | | |
| T3 | 16:34241 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000192 | MF-201 |
| **DOE/CE/40637–** | | | | | |
| T9 | 16:34369 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018580 | PC-310 |
| **DOE/CH/10093–** | | | | | |
| 100/1991 | 16:33865 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91002177 | MF-262 |
| 113 | 16:33854 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91002168 | MF-270 |
| **DOE/CH/10378–** | | | | | |
| 9 | 16:33736 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000030 | MF-810 |
| **DOE/DP/40200–** | | | | | |
| 166 | 16:35435 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018828 | MF-712 |
| **DOE/EA–** | | | | | |
| 0467 | 16:35029 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018451 | MF-630 |
| **DOE/EH–** | | | | | |
| 0207P | 16:33802 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000523 | MF-630 |
| 0208P | 16:35479 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018649 | PC-600 |
| 231-005/0991 | 16:34250 | OSTI (Free of Charge) | | TI92000021 | PC-630 |
| **DOE/EIA–** | | | | | |
| 0035(73-88) | 16:34252 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE92000167 | MF-950 |
| 0035(91/08) | 16:34260 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE91017877 | MF-950 |
| 0035(91/09) | 16:34253 | OSTI; NTIS; INIS; GPO; GPO Dep. | E 1.99: | DE92000458 | MF-950 |
| 0109(91/09) | 16:33663 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE92000613 | MF-950 |
| 0118(90) | 16:33642 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE91018995 | MF-950 |
| 0204(91/04) | 16:35557 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE91018838 | MF-950 |
| 0226(91/09) | 16:34261 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE92000083 | MF-950 |
| 0380(91/09) | 16:33664 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE91018972 | MF-950 |
| 0438(91) | 16:34036 | OSTI; NTIS; INIS; GPO; GPO Dep. | E 1.99: | DE91018522 | MF-950 |
| 0515(88) | 16:34371 | OSTI; NTIS; INIS; GPO; GPO Dep. | E 1.99: | DE92000615 | MF-950 |
| 0520(91/09) | 16:33665 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE92000612 | MF-950 |
| 0523(90/4Q) | 16:33666 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE91018914 | MF-950 |
| 0543(91/2Q) | 16:33667 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE91018631 | MF-950 |
| 0544 | 16:33913 | OSTI; NTIS; INIS; GPO; GPO Dep. | E 1.99: | DE92000614 | MF-950 |
| 0549 | 16:33614 | OSTI; NTIS; GPO; GPO Dep. | E 1.99: | DE91018976 | MF-950 |
| **DOE/ER–** | | | | | |
| 0497 | 16:35475 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018499 | MF-400 |
| 0500 | 16:35558 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018496 | MF-400 |
| 0507P | 16:34242 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019006 | MF-400 |
| 0511P | 16:35090 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000518 | MF-408 |
| **DOE/ER/02504–** | | | | | |
| 556 | 16:35199 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018531 | MF-414 |
| **DOE/ER/12823–** | | | | | |
| 2 | 16:33724 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000024 | MF-413 |
| **DOE/ER/13002–** | | | | | |
| 1 | 16:34586 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018202 | MF-404 |
| **DOE/ER/13295–** | | | | | |
| 5 | 16:34604 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018807 | MF-401 |
| **DOE/ER/13299–** | | | | | |
| 7 | 16:34605 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017854 | MF-401 |
| **DOE/ER/13435–** | | | | | |
| 6 | 16:34587 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018526 | MF-401 |
| **DOE/ER/13564–** | | | | | |
| 10 | 16:34606 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018804 | MF-401 |
| **DOE/ER/13582–** | | | | | |
| 5 | 16:34607 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018803 | MF-401 |
| **DOE/ER/13612–** | | | | | |
| 7 | 16:34550 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017726 | MF-401 |
| **DOE/ER/13764–** | | | | | |
| 9 | 16:35176 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000079 | MF-406 |
| **DOE/ER/13820–** | | | | | |
| 1 | 16:34825 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018802 | MF-406 |
| **DOE/ER/13833–** | | | | | |
| 11 | 16:34588 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018528 | MF-401 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| DOE/ER/13865–042 | 16:34608 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018532 | MF-401 |
| DOE/ER/13933–2 | 16:34609 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017712 | MF-401 |
| DOE/ER/13968–T3 | 16:35091 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000019 | MF-408 |
| DOE/ER/14039–2 | 16:34734 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018967 | MF-401 |
| DOE/ER/14054–2 | 16:35092 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018533 | MF-408 |
| DOE/ER/14079–10 | 16:35144 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017370 | MF-403 |
| DOE/ER/14080–2 | 16:33916 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018493 | MF-401 |
| DOE/ER/14146–1 | 16:34610 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017729 | MF-401 |
| DOE/ER/25001–T6 | 16:35502 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000032 | MF-405 |
| DOE/ER/25041–4 | 16:35503 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018872 | MF-405 |
| DOE/ER/25053–6 | 16:35177 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018965 | MF-405 |
| DOE/ER/25084–2 | 16:35178 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018806 | MF-405 |
| DOE/ER/40213–8 | 16:35184 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91017853 | MF-414 |
| DOE/ER/40256–6 | 16:35256 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018530 | MF-414 |
| DOE/ER/40310–5 | 16:34934 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018529 | MF-413 |
| DOE/ER/40316–5 | 16:35257 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000532 | MF-413 |
| DOE/ER/40335–6 | 16:35304 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000022 | MF-413 |
| DOE/ER/40406–4 | 16:35258 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000533 | MF-413 |
| DOE/ER/40414–4 | 16:35259 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000636 | MF-413 |
| DOE/ER/40465–T2 | 16:34858 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000824 | MF-414 |
| DOE/ER/40537–9 | 16:35305 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000825 | MF-413 |
| DOE/ER/40592–1 | 16:35260 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018012 | MF-413 |
| DOE/ER/40613–1 | 16:34888 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000081 | MF-414 |
| DOE/ER/52122–6 | 16:35436 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000020 | MF-421 |
| DOE/ER/52127–81 | 16:35437 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000761 | MF-427 |
| DOE/ER/53198–180 | 16:35383 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000161 | PC-426 |
| 181 | 16:35384 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000162 | PC-426 |
| 182 | 16:35385 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000164 | PC-426 |
| DOE/ER/53207–6 | 16:35386 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000053 | MF-421 |
| DOE/ER/53223–169 | 16:35387 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018913 | MF-420 |
| DOE/ER/53256–1 | 16:35388 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018740 | MF-426 |
| 2 | 16:35389 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018741 | MF-426 |
| 3 | 16:35390 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018742 | MF-426 |
| DOE/ER/53279–1 | 16:35376 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018011 | MF-420 |
| DOE/ER/60227–6 | 16:34996 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000033 | MF-402 |
| DOE/ER/60519–T3 | 16:35099 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000786 | MF-408 |
| DOE/ER/60615–T1 | 16:33737 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018946 | MF-400 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **DOE/ER/60636–** | | | | | |
| T4 | 16:35093 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000706 | MF-408 |
| **DOE/ER/60676–** | | | | | |
| T1 | 16:35094 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000759 | MF-408 |
| **DOE/ER/60874–** | | | | | |
| 2 | 16:35100 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018873 | MF-406 |
| **DOE/ER/61058–** | | | | | |
| 1 | 16:34956 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000080 | MF-406 |
| **DOE/ER/61060–** | | | | | |
| 1 | 16:34963 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018373 | MF-402 |
| **DOE/ER/61064–** | | | | | |
| 1 | 16:35313 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018869 | MF-405 |
| **DOE/ER/61139–** | | | | | |
| 1 | 16:35095 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92001741 | MF-408 |
| **DOE/ET/15601–** | | | | | |
| 40 | 16:34273 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000632 | MF-112 |
| **DOE/ET/53088–** | | | | | |
| 518 | 16:35391 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018891 | MF-420 |
| **DOE/EV/72012–** | | | | | |
| T1 | 16:35145 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000530 | MF-403 |
| **DOE/FE–** | | | | | |
| 0236P | 16:33966 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018504 | MF-101 |
| 0240P | 16:33548 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017915 | MF-101 |
| **DOE/FE/61614–** | | | | | |
| T1 | 16:33620 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018974 | MF-103 |
| **DOE/HWP–** | | | | | |
| 106-Vol.2 | 16:33738 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018446 | MF-902 |
| **DOE/ID–** | | | | | |
| 10326 | 16:33658 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91002248 | PC-122 |
| 10333 | 16:33739 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018761 | MF-902 |
| 12118 | 16:35146 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018697 | MF-502 |
| 22096 | 16:35075 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018691 | MF-502 |
| **DOE/ID/12584–** | | | | | |
| 77 | 16:35127 | *See* UCRL-CR–104682-Rev.1 | | | |
| **DOE/ID/12735–** | | | | | |
| T18 | 16:34274 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000396 | MF-112 |
| **DOE/JIO–** | | | | | |
| 005 | 16:33740 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000929 | MF-902 |
| 006 | 16:33741 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000931 | MF-902; MF-721 |
| 019 | 16:33742 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000872 | MF-902 |
| 020 | 16:33743 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000877 | MF-902 |
| 021 | 16:33744 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000930 | MF-902 |
| 024 | 16:33745 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000881 | MF-902 |
| **DOE/LLW–** | | | | | |
| 132 | 16:33746 | OSTI; NTIS; INIS; GPO; GPO Dep. | E 1.99: | DE92000224 | PC-512 |
| **DOE/NE/37967–** | | | | | |
| T5 | 16:34781 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018835 | MF-520 |
| **DOE/NV–** | | | | | |
| 345 | 16:33747 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000278 | MF-721 |
| **DOE/NV/10845–** | | | | | |
| 2 | 16:35030 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018825 | MF-702 |
| 67 | 16:35031 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000109 | MF-702 |
| **DOE/OR–** | | | | | |
| 968 | 16:35032 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000028 | MF-902 |
| **DOE/OR/00033–** | | | | | |
| T449 | 16:34782 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018189 | MF-400 |
| T452 | 16:35480 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018192 | MF-400; MF-500 |
| **DOE/OR/21389–** | | | | | |
| 32 | 16:33846 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018706 | MF-247 |
| 33 | 16:33847 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018707 | MF-247 |
| **DOE/OR/21949–** | | | | | |
| 288 | 16:33803 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91017593 | MF-900 |
| **DOE/PC/70768–** | | | | | |
| 1 | 16:33623 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000200 | MF-108 |
| 4 | 16:33624 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000201 | MF-108 |
| 5 | 16:33625 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000202 | MF-108 |
| 8 | 16:33626 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000203 | MF-104 |
| 9 | 16:33557 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000204 | MF-108 |
| 10 | 16:33627 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000211 | MF-108 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 11 | 16:33628 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000214 | MF-108 |
| 12 | 16:33629 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000216 | MF-108 |
| **DOE/PC/79661–** | | | | | |
| T9 | 16:33630 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018314 | PC-104 |
| **DOE/PC/79798–** | | | | | |
| T12 | 16:33977 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91014762 | MF-105 |
| **DOE/PC/79886–** | | | | | |
| T1 | 16:33558 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017023 | PC-102 |
| **DOE/PC/79892–** | | | | | |
| T15 | 16:33541 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000330 | MF-102 |
| **DOE/PC/79921–** | | | | | |
| T10 | 16:33559 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91013896 | MF-106 |
| T9 | 16:34529 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91013897 | MF-106 |
| **DOE/PC/79930–** | | | | | |
| T6 | 16:33560 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018325 | MF-109 |
| **DOE/PC/79938–** | | | | | |
| T6 | 16:33561 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000333 | MF-108 |
| **DOE/PC/88913–** | | | | | |
| T9 | 16:33631 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000340 | MF-103 |
| **DOE/PC/88921–** | | | | | |
| 9 | 16:33591 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000301 | MF-102 |
| 10 | 16:33592 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000295 | MF-102 |
| **DOE/PC/88922–** | | | | | |
| 12 | 16:33562 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018629 | MF-102 |
| **DOE/PC/88933–** | | | | | |
| 10 | 16:33563 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018163 | MF-113 |
| **DOE/PC/88937–** | | | | | |
| T10 | 16:33632 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018328 | MF-103 |
| **DOE/PC/88939–** | | | | | |
| T2 | 16:33593 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018627 | MF-102 |
| **DOE/PC/88943–** | | | | | |
| T3 | 16:33601 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018259 | PC-113 |
| **DOE/PC/89758–** | | | | | |
| T4 | 16:33542 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000341 | MF-105 |
| **DOE/PC/89759–** | | | | | |
| T7 | 16:33564 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018338 | MF-104 |
| **DOE/PC/89771–** | | | | | |
| 7 | 16:33565 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018331 | MF-102 |
| **DOE/PC/89773–** | | | | | |
| 5 | 16:33566 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000310 | MF-104 |
| 6 | 16:33567 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018611 | MF-104 |
| **DOE/PC/89775–** | | | | | |
| 5 | 16:33568 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018084 | MF-102 |
| **DOE/PC/89776–** | | | | | |
| T3 | 16:33633 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000354 | MF-104 |
| **DOE/PC/89793–** | | | | | |
| T4 | 16:33569 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017171 | MF-113 |
| **DOE/PC/89805–** | | | | | |
| 5 | 16:33602 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018625 | MF-105 |
| **DOE/PC/89876–** | | | | | |
| T3 | 16:33570 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018626 | MF-108 |
| **DOE/PC/89883–** | | | | | |
| 23 | 16:33571 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018668 | MF-108 |
| **DOE/PC/90029–** | | | | | |
| T1 | 16:33572 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91013954 | MF-108 |
| T3 | 16:33573 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018341 | MF-108 |
| **DOE/PC/90048–** | | | | | |
| T1 | 16:33574 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000446 | MF-108 |
| **DOE/PC/90098–** | | | | | |
| T1 | 16:33968 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018737 | MF-105 |
| T2 | 16:33969 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018738 | MF-105 |
| **DOE/PC/90160–** | | | | | |
| T2 | 16:33634 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018324 | MF-113 |
| **DOE/PC/90174–** | | | | | |
| T3 | 16:33543 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018662 | MF-102 |
| **DOE/PC/90176–** | | | | | |
| T42 | 16:33575 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018306 | MF-102 |
| T44 | 16:33544 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018308 | MF-102 |
| **DOE/PC/90183–** | | | | | |
| T2 | 16:33615 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018158 | MF-117 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **DOE/PC/90286–** | | | | | |
| T2 | 16:33635 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018612 | MF-103 |
| **DOE/PC/90288–** | | | | | |
| T1 | 16:33576 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018736 | MF-108 |
| **DOE/PC/90289–** | | | | | |
| T2 | 16:33577 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018664 | MF-108 |
| **DOE/PC/90292–** | | | | | |
| T3 | 16:33978 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018667 | MF-105 |
| **DOE/PC/90293–** | | | | | |
| 4 | 16:33578 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018670 | MF-113 |
| **DOE/PC/90298–** | | | | | |
| T4 | 16:33594 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000334 | MF-113 |
| **DOE/PC/90302–** | | | | | |
| T2 | 16:33579 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018327 | MF-108 |
| **DOE/PC/90305–** | | | | | |
| T3 | 16:33580 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000332 | MF-113 |
| **DOE/PC/90306–** | | | | | |
| T1 | 16:34965 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018364 | MF-115 |
| **DOE/PC/90307–** | | | | | |
| 2 | 16:33581 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018330 | MF-109 |
| **DOE/PC/90309–** | | | | | |
| 3 | 16:33979 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000304 | MF-105 |
| **DOE/PC/90312–** | | | | | |
| T3 | 16:33582 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018614 | MF-105 |
| **DOE/PC/90361–** | | | | | |
| T3 | 16:33980 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018665 | MF-105 |
| **DOE/PC/90547–** | | | | | |
| T3 | 16:33970 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018323 | MF-105 |
| **DOE/PC/90548–** | | | | | |
| T2 | 16:33981 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018335 | MF-105 |
| **DOE/PC/91026–** | | | | | |
| T1 | 16:33583 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018739 | MF-108 |
| **DOE/PE/77029–** | | | | | |
| T1 | 16:34266 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018953 | MF-900 |
| T4 | 16:34267 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018956 | MF-900 |
| T5 | 16:34268 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018957 | MF-900 |
| T6 | 16:34269 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018958 | MF-900 |
| **DOE/PETC/TR–** | | | | | |
| 91/10 | 16:33616 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018698 | PC-114 |
| 91/6 | 16:33596 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91015938 | PC-102 |
| 91/9 | 16:33545 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018699 | PC-102 |
| **DOE/RL–** | | | | | |
| 01830T-H11 | 16:34999 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018606 | PC-402 |
| 01830T-H12 | 16:35000 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018607 | PC-402 |
| 01830T-H13 | 16:35001 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018608 | PC-402 |
| 01830T-H6 | 16:34997 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018601 | PC-402 |
| 01830T-H7 | 16:34998 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018602 | PC-402 |
| 01830T-H9 | 16:33849 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018604 | PC-402 |
| 91-30 | 16:33804 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000885 | MF-402 |
| 91-47 | 16:35076 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000244 | MF-702 |
| **DOE/RL/11746–** | | | | | |
| T2 | 16:34317 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018940 | MF-232 |
| **DOE/RW–** | | | | | |
| 0043-Rev.4 | 16:33748 | OSTI; OSTI (Free of Charge); INIS | | TI91019017 | MF-800 |
| 0074 | 16:33749 | OSTI (Free of Charge); INIS | | TI91017500 | MF-802 |
| **DOE/S–** | | | | | |
| 0085P | 16:34217 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018505 | MF-920 |
| 0088P | 16:33659 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018506 | MF-930 |
| **DOE/SF/11634–** | | | | | |
| T1 | 16:34271 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018875 | MF-270; MF-261; MF-246 |
| **DOE/SF/15522–** | | | | | |
| T1 | 16:35147 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018951 | MF-251 |
| **DOE/SF/16308–** | | | | | |
| T2 | 16:33866 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000400 | MF-232 |
| **DOE/SF/16518–** | | | | | |
| T2 | 16:34983 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000398 | MF-706 |
| T3 | 16:34984 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000399 | MF-706 |
| **DTH-LET-RE–** | | | | | |
| 90-6 | 16:33698 | OSTI; NTIS (US Sales Only) | | DE92703858 | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 90-7 | 16:33652 | OSTI; NTIS (US Sales Only) | | DE92703859 | |
| 90-9 | 16:35002 | OSTI; NTIS (US Sales Only) | | DE92703922 | |
| **DTP–** | | | | | |
| 91/16 | 16:35218 | *See* DESY–91-039 | | | |
| **DUH–** | | | | | |
| 12040 | 16:33721 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000300 | MF-700 |
| **DUN–** | | | | | |
| 5000-Pt.1 | 16:34134 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000543 | MF-700 |
| 5000-Pt.2 | 16:34135 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000573 | MF-700 |
| 5000-Suppl.1 | 16:34065 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000544 | MF-700 |
| 5000-Suppl.10 | 16:34144 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000555 | MF-700 |
| 5000-Suppl.11 | 16:34145 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000557 | MF-507 |
| 5000-Suppl.12 | 16:34146 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000558 | MF-507 |
| 5000-Suppl.13 | 16:34147 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000559 | MF-507 |
| 5000-Suppl.14 | 16:34148 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000560 | MF-507 |
| 5000-Suppl.15 | 16:34149 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000561 | MF-507 |
| 5000-Suppl.16 | 16:34150 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000562 | MF-507 |
| 5000-Suppl.17-Add.1 | 16:34151 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000563 | MF-700 |
| 5000-Suppl.18 | 16:34152 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000564 | MF-700 |
| 5000-Suppl.19 | 16:34153 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000565 | MF-700 |
| 5000-Suppl.2 | 16:34136 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000547 | MF-700 |
| 5000-Suppl.20 | 16:34154 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000566 | MF-700 |
| 5000-Suppl.21 | 16:34155 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000567 | MF-700 |
| 5000-Suppl.22 | 16:34156 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000568 | MF-700 |
| 5000-Suppl.23 | 16:34157 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000569 | MF-700 |
| 5000-Suppl.24 | 16:34158 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000570 | MF-700 |
| 5000-Suppl.25 | 16:34159 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000571 | MF-700 |
| 5000-Suppl.26 | 16:34160 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000572 | MF-700 |
| 5000-Suppl.3 | 16:34137 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000548 | MF-700 |
| 5000-Suppl.4 | 16:34138 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000549 | MF-700 |
| 5000-Suppl.5 | 16:34139 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000550 | MF-700 |
| 5000-Suppl.6 | 16:34140 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000551 | MF-700 |
| 5000-Suppl.7 | 16:34141 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000541 | MF-700 |
| 5000-Suppl.8 | 16:34142 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000553 | MF-700 |
| 5000-Suppl.9 | 16:34143 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000554 | MF-700 |
| 559 | 16:34133 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000574 | MF-700 |
| **EGG–** | | | | | |
| 10617-2094 | 16:35098 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018987 | MF-702 |
| 1183-1412 | 16:35033 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018218 | MF-702 |
| 1183-1423 | 16:35003 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018194 | MF-702 |
| 1183-1432 | 16:35314 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018217 | MF-702 |
| 1183-1466 | 16:35034 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018216 | MF-702 |
| 1183-1525 | 16:35035 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018214 | MF-702 |
| 1183-1565 | 16:35036 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018213 | MF-702 |
| 1183-1569 | 16:35037 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018212 | MF-702 |
| 1183-1570 | 16:35038 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018209 | MF-702 |
| 1183-1571 | 16:35039 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018210 | MF-702 |
| 1183-1573 | 16:35040 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018211 | MF-702 |
| 1183-1578 | 16:35041 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018207 | MF-702 |
| 1183-1586 | 16:35042 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018208 | MF-702 |
| 1183-1594 | 16:35043 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018206 | MF-702 |
| 1183-1624 | 16:35044 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018195 | MF-702 |
| 1183-1646 | 16:35045 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018204 | MF-702 |
| 1183-1647 | 16:35046 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018203 | MF-702 |
| 1183-1649 | 16:35047 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018193 | MF-702 |
| 1183-1657 | 16:35048 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018201 | MF-702 |
| 1183-1698 | 16:35049 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018200 | MF-702 |
| 1183-1708 | 16:35050 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018199 | MF-702 |
| 1183-1715 | 16:35051 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018198 | |
| 1183-1728 | 16:35052 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018197 | MF-702 |
| 1183-1731 | 16:35004 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018196 | MF-702 |
| **EGG-BG–** | | | | | |
| 9249 | 16:35148 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018744 | MF-903 |
| **EGG-CS–** | | | | | |
| 9762 | 16:34966 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018695 | MF-406 |
| **EGG-EAST–** | | | | | |
| 9352 | 16:34038 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018749 | MF-706 |
| **EGG-EE–** | | | | | |
| 9479 | 16:35504 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018692 | MF-700 |
| **EGG-FSP–** | | | | | |
| 9789 | 16:35438 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018717 | MF-423 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **EGG-M–** | | | | | |
| 89238 | 16:35053 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018694 | MF-902; MF-940 |
| 90299 | 16:34372 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018708 | |
| 90355 | 16:33584 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018710 | MF-102 |
| 90460 | 16:35054 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018750 | MF-510 |
| 90534 | 16:34037 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018752 | MF-507 |
| 91047 | 16:33987 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018696 | |
| 91102 | 16:33660 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018747 | MF-102 |
| 91113 | 16:34243 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018760 | MF-528 |
| 91257 | 16:35179 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018820 | MF-410 |
| 91290 | 16:34444 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018745 | MF-312 |
| 91291 | 16:34445 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018746 | MF-312 |
| 91352 | 16:34247 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018832 | MF-743 |
| **EGG-MS–** | | | | | |
| 9726 | 16:34987 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018759 | MF-700 |
| **EGG-WM–** | | | | | |
| 9732 | 16:33805 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018758 | MF-907 |
| **EGG-WTD–** | | | | | |
| 9671 | 16:34212 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018787 | MF-902 |
| 9736 | 16:35055 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018830 | MF-602 |
| 9749 | 16:35056 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018785 | MF-902 |
| 9765 | 16:34783 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018786 | MF-902; MF-906 |
| 9780 | 16:33750 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018833 | MF-906 |
| **ENEA-RT-INN–** | | | | | |
| 90-02 | 16:34842 | OSTI; NTIS (US Sales Only) | | DE92705827 | |
| **ENEA-RTI-DCS–** | | | | | |
| 90-03 | 16:33982 | OSTI; NTIS (US Sales Only) | | DE92705887 | |
| **ENEA-RTI-FARE–** | | | | | |
| 90-18 | 16:33867 | OSTI; NTIS (US Sales Only) | | DE92705863 | |
| **ENEA-RTI-INN–** | | | | | |
| 91-02 | 16:34859 | OSTI; NTIS (US Sales Only) | | DE92705884 | |
| 91-04 | 16:35439 | OSTI; NTIS (US Sales Only) | | DE92705889 | |
| 91-11 | 16:34530 | OSTI; NTIS (US Sales Only) | | DE92705888 | |
| **ENEA-RTI-INT–** | | | | | |
| 91-01 | 16:34373 | OSTI; NTIS (US Sales Only) | | DE92705885 | |
| **ENEA-RTI-STUDI-STRAT–** | | | | | |
| 90-08 | 16:34227 | OSTI; NTIS (US Sales Only) | | DE92705866 | |
| **ENET–** | | | | | |
| 8900008/3 | 16:33830 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714217 | |
| 8900031/2 | 16:33905 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714229 | |
| 8900168/3 | 16:33868 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714218 | |
| 8900168/4 | 16:33869 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714221 | |
| 8900168/5 | 16:34318 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714220 | |
| 8900170/1 | 16:33870 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714223 | |
| 8900188/1 | 16:34374 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714222 | |
| 8900332/1 | 16:33917 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714224 | |
| 8900424/1 | 16:34319 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714228 | |
| 8900424/2 | 16:34320 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714227 | |
| 8900424/3 | 16:35077 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714225 | |
| 8900437/1 | 16:33906 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714230 | |
| 8900437/2 | 16:33907 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714231 | |
| 8900437/3 | 16:33908 | OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, CH-3006 Bern (CH) | | DE92714232 | |
| **ES/CSET–** | | | | | |
| 9 | 16:34161 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000419 | MF-630 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **ES/ER–** | | | | | |
| 20 | 16:35032 | *See* DOE/OR–968 | | | |
| 21-D3 | 16:33810 | *See* Y/ER–18/R1 | | | |
| **ES/ESH–** | | | | | |
| 18/V1 | 16:34230 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000406 | MF-402 |
| 18/V2 | 16:34231 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000407 | MF-402 |
| 18/V3 | 16:34232 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000405 | MF-402 |
| 18/V4 | 16:34233 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000404 | MF-402 |
| **ESG–** | | | | | |
| 152 | 16:34907 | *See* LBL–31196 | | | |
| **ESL-TR–** | | | | | |
| 89-61 | 16:34512 | *See* MISC–90071 | | | |
| **ETDE-IT–** | | | | | |
| 91-52 | 16:34215 | OSTI; NTIS (US Sales Only) | | DE92705848 | |
| 91-53 | 16:34218 | OSTI; NTIS (US Sales Only) | | DE92705849 | |
| 91-54 | 16:35005 | OSTI; NTIS (US Sales Only) | | DE92705886 | |
| 91-55 | 16:34589 | OSTI; NTIS (US Sales Only) | | DE92705865 | |
| **ETDE-mf–** | | | | | |
| 2704338 | 16:35131 | OSTI; NTIS (US Sales Only) | | DE92704338 | |
| 2704458 | 16:35132 | OSTI; NTIS (US Sales Only) | | DE92704458 | |
| 2704460 | 16:34234 | OSTI; NTIS (US Sales Only) | | DE92704460 | |
| 2704465 | 16:35006 | OSTI; NTIS (US Sales Only) | | DE92704465 | |
| 2704498 | 16:33871 | OSTI; NTIS (US Sales Only) | | DE92704498 | |
| 2704574 | 16:35078 | OSTI; NTIS (US Sales Only) | | DE92704574 | |
| 2704576 | 16:33603 | OSTI; NTIS (US Sales Only) | | DE92704576 | |
| 2704578 | 16:33872 | OSTI; NTIS (US Sales Only) | | DE92704578 | |
| 2711100 | 16:34228 | OSTI; NTIS (US Sales Only) | | DE92711100 | |
| 2711162 | 16:34826 | OSTI; NTIS (US Sales Only) | | DE92711162 | |
| 2711163 | 16:34375 | OSTI; NTIS (US Sales Only) | | DE92711163 | |
| 2714297 | 16:35007 | OSTI; NTIS (US Sales Only) | | DE92714297 | |
| 2714313 | 16:35008 | OSTI; NTIS (US Sales Only) | | DE92714313 | |
| 2714356 | 16:33912 | OSTI; NTIS (US Sales Only) | | DE92714356 | |
| 2714365 | 16:33617 | OSTI; NTIS (US Sales Only) | | DE92714365 | |
| 2714390 | 16:34262 | OSTI; NTIS (US Sales Only) | | DE92714390 | |
| 2714401 | 16:34235 | OSTI; NTIS (US Sales Only) | | DE92714401 | |
| 2714418 | 16:34226 | OSTI; NTIS (US Sales Only) | | DE92714418 | |
| **ETDE/ES-mf–** | | | | | |
| 2700015 | 16:34935 | OSTI; NTIS (US Sales Only) | | DE92700015 | |
| **ETDE/JP-mf–** | | | | | |
| 2709542 | 16:34321 | OSTI; NTIS (US Sales Only) | | DE92709542 | |
| 2709570 | 16:34611 | OSTI; NTIS (US Sales Only) | | DE92709570 | |
| **ETSU-B–** | | | | | |
| 1234S | 16:33836 | OSTI; NTIS (US Sales Only) | | DE92709674 | |
| 7052S | 16:33844 | OSTI; NTIS (US Sales Only) | | DE92709675 | |
| **EUR–** | | | | | |
| 12320-Vol.2 | 16:34162 | OSTI; NTIS (US Sales Only) | | TI92703750 | |
| 12603 | 16:34183 | OSTI; NTIS (US Sales Only) | | TI92703741 | |
| 12914 | 16:34376 | OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg | | TI91018379 | |
| 12948 | 16:33751 | OSTI; NTIS (US Sales Only) | | TI92703665 | |
| 12949 | 16:33832 | OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg | | TI91018380 | |
| 12990 | 16:35009 | OSTI; NTIS (US Sales Only) | | TI92703670 | |
| 13023 | 16:33833 | OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg | | TI91018381 | |
| 13088 | 16:33837 | OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5 | | TI91018384 | |
| 13133 | 16:33752 | OSTI; NTIS (US Sales Only) | | TI92703662 | |
| 13185 | 16:34393 | OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg | | TI91018385 | |
| 13253 | 16:33753 | OSTI; NTIS (US Sales Only) | | TI92703667 | |
| 13262 | 16:35057 | OSTI; NTIS (US Sales Only) | | TI92703666 | |
| 13280 | 16:35058 | OSTI; NTIS (US Sales Only) | | TI92703664 | |
| 13307 | 16:34936 | OSTI; NTIS (US Sales Only) | | TI92703656 | |
| 13315 | 16:35059 | OSTI; NTIS (US Sales Only) | | TI92703657 | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 13318 | 16:33754 | OSTI; NTIS (US Sales Only) | | TI92703663 | |
| 13345 | 16:34784 | OSTI; NTIS (US Sales Only) | | TI92703659 | |
| 13356 | 16:33755 | OSTI; NTIS (US Sales Only) | | TI92703661 | |
| 13379 | 16:34590 | OSTI; NTIS (US Sales Only) | | TI92703668 | |
| 13406 | 16:35149 | OSTI; NTIS (US Sales Only) | | TI92703742 | |
| **EUR-ICP-CEH–** | | | | | |
| 076(S) | 16:35481 | OSTI; NTIS (US Sales Only); INIS | | TI92601580 | |
| **FE–** | | | | | |
| 15601-40 | 16:34273 | *See* DOE/ET/15601–40 | | | |
| **FE-MIT–** | | | | | |
| 89773-5 | 16:33566 | *See* DOE/PC/89773–5 | | | |
| 89773-6 | 16:33567 | *See* DOE/PC/89773–6 | | | |
| **FFU-rep–** | | | | | |
| 90-12 | 16:34028 | OSTI; NTIS (US Sales Only); INIS | | DE92714353 | |
| **FMPC–** | | | | | |
| 2222 | 16:33806 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018559 | MF-702 |
| 2227 | 16:33756 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018558 | MF-706 |
| 2238 | 16:33757 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018817 | MF-721 |
| 2240 | 16:33758 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018818 | MF-721 |
| **FNAL-TM–** | | | | | |
| 1753 | 16:34938 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000598 | PC-414 |
| 1754 | 16:34845 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000599 | PC-406 |
| **FNAL/C–** | | | | | |
| 91/188 | 16:34919 | *See* SSCL–487 | | | |
| 91/200 | 16:35227 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018890 | MF-414 |
| 91/216 | 16:35200 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018960 | MF-414 |
| 91/223-E | 16:35201 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000156 | MF-414 |
| 91/225 | 16:35228 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000470 | MF-414 |
| 91/227 | 16:35202 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000155 | MF-414 |
| 91/234-E | 16:35203 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000638 | MF-414 |
| 91/236-E | 16:35204 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000471 | MF-414 |
| 91/237-E | 16:35205 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000640 | MF-414 |
| 91/238-E | 16:35206 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000637 | MF-414 |
| 91/241 | 16:34937 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000472 | MF-414 |
| **FhG-IWM-W–** | | | | | |
| 13/90 | 16:34446 | OSTI; NTIS (US Sales Only); INIS | | DE92714295 | |
| 8/90 | 16:34531 | OSTI; NTIS (US Sales Only); INIS | | DE92714269 | |
| **FhG-IzfP–** | | | | | |
| 900126-TW | 16:34834 | OSTI; NTIS (US Sales Only); INIS | | DE92714277 | |
| **GA-A–** | | | | | |
| 20614 | 16:35392 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000262 | MF-421 |
| 20624 | 16:35440 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000288 | MF-420 |
| 20627 | 16:35441 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018732 | MF-421 |
| **GANIL-T–** | | | | | |
| 91-01 | 16:34939 | OSTI; NTIS (US Sales Only) | | DE92703740 | |
| **GB–** | | | | | |
| 381 | 16:34229 | OSTI; NTIS (US Sales Only) | | DE92713271 | |
| **GKSS–** | | | | | |
| 91/E/7 | 16:34447 | OSTI; NTIS (US Sales Only) | | DE92714350 | |
| **GRI–** | | | | | |
| 90/0326 | 16:34328 | *See* LBL–29798 | | | |
| 91/0045 | 16:33717 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000481 | |
| **GSF–** | | | | | |
| 12/91 | 16:33759 | OSTI; NTIS (US Sales Only); INIS | | DE92714639 | |
| 19/91 | 16:33760 | OSTI; NTIS (US Sales Only); INIS | | DE92714522 | |
| 31/90 | 16:33761 | OSTI; NTIS (US Sales Only); INIS | | DE92714357 | |
| **GSF-TL–** | | | | | |
| 13/90 | 16:33760 | *See* GSF–19/91 | | | |
| 35/90 | 16:33761 | *See* GSF–31/90 | | | |
| 7/91 | 16:33759 | *See* GSF–12/91 | | | |
| **GSI–** | | | | | |
| 91-1 | 16:35261 | OSTI; NTIS (US Sales Only); INIS | | DE92704449 | |
| 91-14 | 16:35272 | OSTI; NTIS (US Sales Only); INIS | | DE92704490 | |
| 91-24 | 16:35393 | OSTI; NTIS (US Sales Only); INIS | | DE92714362 | |
| 91-28(prepr.) | 16:35306 | OSTI; NTIS (US Sales Only); INIS | | DE92714434 | |
| 91-29(prepr.) | 16:35307 | OSTI; NTIS (US Sales Only); INIS | | DE92714425 | |
| 91-30(prepr.) | 16:35340 | OSTI; NTIS (US Sales Only); INIS | | DE92714426 | |
| 91-31(prepr.) | 16:35280 | OSTI; NTIS (US Sales Only); INIS | | DE92714424 | |
| 91-32(prepr.) | 16:35288 | OSTI; NTIS (US Sales Only); INIS | | DE92714427 | |
| 91-35(prepr.) | 16:35262 | OSTI; NTIS (US Sales Only); INIS | | DE92714447 | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **HAN–** | | | | | |
| 72947 | 16:34103 | *See* HW–60918 | | | |
| 73609 | 16:34104 | *See* HW–62052 | | | |
| 74275 | 16:34105 | *See* HW–62900 | | | |
| 81834-Del. | 16:34107 | *See* HW–73473 | | | |
| 83451-Del. | 16:34109 | *See* HW–75451 | | | |
| 85233 | 16:34108 | *See* HW–74094-Vol.2 | | | |
| 85705 | 16:34197 | *See* HW–74094-Vol.1 | | | |
| 94154-Del. | 16:34133 | *See* DUN–559 | | | |
| **HD-THEP–** | | | | | |
| 91-09 | 16:35219 | *See* DESY–91-041 | | | |
| **HEW–** | | | | | |
| 7096-Del. | 16:34066 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018564 | MF-700 |
| 7283-Del. | 16:34067 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018766 | MF-700 |
| 7378-Del. | 16:34068 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000303 | MF-700 |
| 7504-Del. | 16:34069 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018767 | MF-700 |
| 7565-Del. | 16:34070 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018903 | MF-700 |
| **HIFAN–** | | | | | |
| 509 | 16:35460 | *See* LBL–30748 | | | |
| **HLRZ–** | | | | | |
| 91-37 | 16:35235 | *See* DESY–91-040 | | | |
| **HMI-B–** | | | | | |
| 485 | 16:35482 | OSTI; NTIS (US Sales Only); INIS | | DE92714363 | |
| 487 | 16:35442 | OSTI; NTIS (US Sales Only); INIS | | DE92714326 | |
| **HW–** | | | | | |
| 10166-Del. | 16:34080 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018781 | MF-700 |
| 10395-Del. | 16:34081 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000321 | MF-700 |
| 10657-Del. | 16:34082 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000322 | MF-700 |
| 12121-Del. | 16:34083 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018905 | MF-700 |
| 12736-Del. | 16:34084 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018906 | MF-700 |
| 12799-Del. | 16:34085 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000323 | MF-700 |
| 13793-Del. | 16:34086 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018776 | MF-700 |
| 14043-Del. | 16:34087 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018777 | MF-700 |
| 14275-Del. | 16:34088 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018907 | MF-700 |
| 14338-Del. | 16:34089 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018567 | MF-700 |
| 14596-Del. | 16:34090 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018778 | MF-700 |
| 14916-Del. | 16:34091 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018779 | MF-700 |
| 15224-Del. | 16:34092 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018908 | MF-700 |
| 15267-Del. | 16:34093 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018782 | MF-700 |
| 15686-Del. | 16:34094 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018909 | MF-700 |
| 17056-Del. | 16:34095 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018772 | MF-700 |
| 17679 | 16:34096 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000325 | MF-700 |
| 19301-Del. | 16:34097 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000327 | MF-700 |
| 20381-Del. | 16:34098 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000328 | MF-700 |
| 20654-RD | 16:33762 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000329 | MF-702 |
| 24832-Del. | 16:34099 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000338 | MF-520 |
| 25052-Del. | 16:34100 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000339 | MF-520 |
| 34847-Pt.2 | 16:34194 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000542 | MF-700 |
| 34847-Pt.3 | 16:34195 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000538 | MF-700 |
| 34847-Pt.4 | 16:34196 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000539 | MF-700 |
| 40560-Del. | 16:34101 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000346 | MF-520 |
| 43556 | 16:34102 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000344 | MF-520 |
| 55234-Del. | 16:33763 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018911 | MF-711 |
| 60699 | 16:33807 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000350 | MF-507 |
| 60918 | 16:34103 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000534 | MF-700 |
| 62052 | 16:34104 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000583 | MF-520 |
| 62900 | 16:34105 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000535 | MF-700 |
| 67954 | 16:34106 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000578 | MF-700 |
| 7-6184-Del. | 16:34071 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018768 | MF-700 |
| 73473 | 16:34107 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000536 | MF-700 |
| 74094-Vol.1 | 16:34197 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000494 | MF-700 |
| 74094-Vol.2 | 16:34108 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000495 | MF-700 |
| 74095-Suppl.1 | 16:34198 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018773 | MF-700 |
| 74095-Vol.2 | 16:34045 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018775 | MF-700 |
| 74095-Vol.3 | 16:34057 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018780 | MF-700 |
| 75451 | 16:34109 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000522 | MF-700 |
| 76431-RD | 16:34199 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000576 | MF-700 |
| 76596 | 16:34110 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000586 | MF-500 |
| 7795-Del. | 16:34072 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018770 | MF-700 |
| 7997-Del. | 16:34073 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018771 | MF-700 |
| 8267-Del. | 16:34074 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018756 | MF-700 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 8438-Del. | 16:34075 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018762 | MF-700 |
| 9191-Del. | 16:34056 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018763 | MF-700 |
| 9201-Del. | 16:34076 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000320 | MF-700 |
| 9595-Del. | 16:34077 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018764 | MF-700 |
| 9708 | 16:34078 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000496 | MF-700 |
| 9910-Del. | 16:34079 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018904 | MF-700 |
| **IFSR–** | | | | | |
| 518 | 16:35391 | *See* DOE/ET/53088–518 | | | |
| **IKE–** | | | | | |
| 2-85 | 16:33972 | OSTI; NTIS (US Sales Only) | | DE92714374 | |
| **INIS-BR–** | | | | | |
| 2698 | 16:35150 | OSTI; NTIS (US Sales Only); INIS | | DE92601128 | |
| **INIS-SU–** | | | | | |
| 253/A | 16:34579 | OSTI; NTIS (US Sales Only); INIS | | DE92001307 | |
| 266 | 16:35342 | OSTI; NTIS (US Sales Only); INIS | | DE92001306 | |
| 272 | 16:34455 | OSTI; NTIS (US Sales Only); INIS; GPO Dep. | E 1.99: | DE92001305 | |
| 273/A | 16:34428 | OSTI; NTIS (US Sales Only); INIS | | DE92001308 | |
| 276 | 16:34686 | OSTI; NTIS (US Sales Only); INIS | | DE92001312 | |
| **INIS-mf–** | | | | | |
| 14003 | 16:34021 | OSTI; NTIS (US Sales Only); INIS | | DE92711101 | |
| 14008 | 16:35133 | OSTI; NTIS (US Sales Only); INIS | | DE92704409 | |
| 14013 | 16:34827 | OSTI; NTIS (US Sales Only); INIS | | DE92714465 | |
| **INS–** | | | | | |
| 875 | 16:34889 | OSTI; NTIS (US Sales Only); INIS | | DE92704118 | |
| 879 | 16:35363 | OSTI; NTIS (US Sales Only); INIS | | DE92704278 | |
| 880 | 16:34890 | OSTI; NTIS (US Sales Only); INIS | | DE92713911 | |
| 881 | 16:35308 | OSTI; NTIS (US Sales Only); INIS | | DE92704182 | |
| 883 | 16:34891 | OSTI; NTIS (US Sales Only); INIS | | DE92713942 | |
| **IPP–** | | | | | |
| 1/260 | 16:35445 | OSTI; NTIS (US Sales Only); INIS | | DE92714328 | |
| 2/312 | 16:35394 | OSTI; NTIS (US Sales Only); INIS | | DE92714339 | |
| 4/246 | 16:35395 | OSTI; NTIS (US Sales Only); INIS | | DE92714340 | |
| 5/40 | 16:35446 | OSTI; NTIS (US Sales Only); INIS | | DE92714338 | |
| 6/298 | 16:35396 | OSTI; NTIS (US Sales Only); INIS | | DE92714301 | |
| III/175 | 16:35397 | OSTI; NTIS (US Sales Only); INIS | | DE92714342 | |
| III/176 | 16:35398 | OSTI; NTIS (US Sales Only); INIS | | DE92714300 | |
| III/177 | 16:35399 | OSTI; NTIS (US Sales Only); INIS | | DE92714327 | |
| III/180 | 16:35400 | OSTI; NTIS (US Sales Only); INIS | | DE92714653 | |
| **IS–** | | | | | |
| 5055 | 16:35505 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000525 | MF-405 |
| **IS-T–** | | | | | |
| 1412 | 16:34728 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018168 | MF-401 |
| 1423 | 16:33597 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018124 | MF-401 |
| 1504 | 16:34563 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018554 | MF-401 |
| 1514 | 16:34967 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000152 | MF-406 |
| 1542 | 16:34493 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018287 | MF-401 |
| 1564 | 16:34494 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018286 | MF-404 |
| 1567 | 16:34729 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018555 | MF-401 |
| 1572 | 16:34592 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018166 | MF-401 |
| **ISPO–** | | | | | |
| 331 | 16:33727 | *See* LA–12149-MS | | | |
| 333 | 16:34596 | *See* ORNL/CSD/TM–282 | | | |
| **JAERI-M–** | | | | | |
| 91-038 | 16:35483 | OSTI; NTIS (US Sales Only); INIS | | DE92713850 | |
| 91-048 | 16:35447 | OSTI; NTIS (US Sales Only); INIS | | DE92704084 | |
| 91-054 | 16:34761 | OSTI; NTIS (US Sales Only); INIS | | DE92704085 | |
| 91-068 | 16:34922 | OSTI; NTIS (US Sales Only); INIS | | DE92704086 | |
| 91-080 | 16:35448 | OSTI; NTIS (US Sales Only); INIS | | DE92704286 | |
| 91-081 | 16:35449 | OSTI; NTIS (US Sales Only); INIS | | DE92713919 | |
| 91-083 | 16:34061 | OSTI; NTIS (US Sales Only); INIS | | DE92713918 | |
| 91-086 | 16:34828 | OSTI; NTIS (US Sales Only); INIS | | DE92704099 | |
| 91-087 | 16:34062 | OSTI; NTIS (US Sales Only); INIS | | DE92704178 | |
| 91-088 | 16:34048 | OSTI; NTIS (US Sales Only); INIS | | DE92713913 | |
| 91-089 | 16:35450 | OSTI; NTIS (US Sales Only); INIS | | DE92704100 | |
| 91-090 | 16:34564 | OSTI; NTIS (US Sales Only); INIS | | DE92704180 | |
| 91-091 | 16:33726 | OSTI; NTIS (US Sales Only); INIS | | DE92713860 | |
| 91-092 | 16:34495 | OSTI; NTIS (US Sales Only); INIS | | DE92704101 | |
| 91-093 | 16:34201 | OSTI; NTIS (US Sales Only); INIS | | DE92713914 | |
| 91-096 | 16:34049 | OSTI; NTIS (US Sales Only); INIS | | DE92713859 | |
| 91-097 | 16:33764 | OSTI; NTIS (US Sales Only); INIS | | DE92713915 | |
| 91-098 | 16:35560 | OSTI; NTIS (US Sales Only); INIS | | DE92704284 | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 91-101 | 16:34789 | OSTI; NTIS (US Sales Only); INIS | | DE92704290 | |
| 91-104 | 16:34050 | OSTI; NTIS (US Sales Only); INIS | | DE92713916 | |
| 91-105 | 16:34790 | OSTI; NTIS (US Sales Only); INIS | | DE92713917 | |
| 91-109 | 16:35451 | OSTI; NTIS (US Sales Only); INIS | | DE92704288 | |
| 91-111 | 16:34063 | OSTI; NTIS (US Sales Only); INIS | | DE92713933 | |
| **JINR–** | | | | | |
| 13-89-847 | 16:34892 | OSTI; NTIS (US Sales Only); INIS | | DE92601344 | |
| **JINR-D–** | | | | | |
| 4-89-221 | 16:35155 | OSTI; NTIS (US Sales Only); INIS | | DE92001311 | |
| **JINR-R–** | | | | | |
| 2-89-862 | 16:35370 | OSTI; NTIS (US Sales Only); INIS | | DE92001314 | |
| 6-89-881 | 16:35282 | OSTI; NTIS (US Sales Only); INIS | | DE92600689 | |
| **Juel–** | | | | | |
| 2423 | 16:35401 | OSTI; NTIS (US Sales Only); INIS | | DE92711173 | |
| 2424 | 16:34968 | OSTI; NTIS (US Sales Only) | | DE92711333 | |
| 2432 | 16:35402 | OSTI; NTIS (US Sales Only); INIS | | DE92711172 | |
| 2446 | 16:35164 | OSTI; NTIS (US Sales Only) | | DE92714420 | |
| 2452 | 16:34593 | OSTI; NTIS (US Sales Only); INIS | | DE92714421 | |
| 2456 | 16:34496 | OSTI; NTIS (US Sales Only); INIS | | DE92711317 | |
| 2461 | 16:34497 | OSTI; NTIS (US Sales Only); INIS | | DE92711318 | |
| 2467 | 16:34051 | OSTI; NTIS (US Sales Only); INIS | | DE92714364 | |
| 2468 | 16:34052 | OSTI; NTIS (US Sales Only); INIS | | DE92714341 | |
| 2488 | 16:35012 | OSTI; NTIS (US Sales Only) | | DE92714345 | |
| **K/TR–** | | | | | |
| 91/1 | 16:33766 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018441 | MF-406 |
| 91/3 | 16:33767 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018440 | MF-706 |
| **KCP–** | | | | | |
| 613-4397 | 16:34498 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000661 | PC-706 |
| 613-4624 | 16:35506 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000464 | MF-706 |
| 613-4673 | 16:34846 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000463 | MF-706 |
| **KEK–** | | | | | |
| 90-21 | 16:34874 | OSTI; NTIS (US Sales Only); INIS | | DE92713858 | |
| 90-22 | 16:35207 | OSTI; NTIS (US Sales Only); INIS | | DE92704307 | |
| 90-25(v.1) | 16:34893 | OSTI; NTIS (US Sales Only); INIS | | DE92713960 | |
| 90-25(v.2) | 16:34894 | OSTI; NTIS (US Sales Only); INIS | | DE92713961 | |
| 91-1 | 16:34875 | OSTI; NTIS (US Sales Only); INIS | | DE92713932 | |
| **KEK-PR–** | | | | | |
| 90-1 | 16:35165 | OSTI; NTIS (US Sales Only); INIS | | DE92713849 | |
| 90-2 | 16:35348 | OSTI; NTIS (US Sales Only); INIS | | DE92704329 | |
| 90-3 | 16:35484 | OSTI; NTIS (US Sales Only); INIS | | DE92704339 | |
| **KFA-STE-IB–** | | | | | |
| 1/90 | 16:33909 | OSTI; NTIS (US Sales Only) | | DE92714337 | |
| **KFK–** | | | | | |
| 4590 | 16:34594 | OSTI; NTIS (US Sales Only); INIS | | DE92714303 | |
| 4763 | 16:35269 | OSTI; NTIS (US Sales Only); INIS | | DE92711239 | |
| 4773 | 16:34829 | OSTI; NTIS (US Sales Only); INIS | | DE92714468 | |
| 4798 | 16:34024 | OSTI; NTIS (US Sales Only); INIS | | DE92714469 | |
| 4802 | 16:35172 | OSTI; NTIS (US Sales Only); INIS | | DE92711541 | |
| 4808 | 16:34860 | OSTI; NTIS (US Sales Only) | | DE92711236 | |
| 4833 | 16:33765 | OSTI; NTIS (US Sales Only); INIS | | DE92714352 | |
| 4841 | 16:35185 | OSTI; NTIS (US Sales Only); INIS | | DE92714354 | |
| 4843 | 16:34537 | OSTI; NTIS (US Sales Only); INIS | | DE92711441 | |
| 4854 | 16:34202 | OSTI; NTIS (US Sales Only); INIS | | DE92714344 | |
| 4860 | 16:34830 | OSTI; NTIS (US Sales Only) | | DE92711512 | |
| 4866 | 16:33813 | OSTI; NTIS (US Sales Only); INIS | | DE92714346 | |
| 4869 | 16:35079 | OSTI; NTIS (US Sales Only) | | DE92714343 | |
| 4870 | 16:35287 | OSTI; NTIS (US Sales Only); INIS | | DE92711168 | |
| 4872 | 16:34595 | OSTI; NTIS (US Sales Only); INIS | | DE92714348 | |
| 4874 | 16:34538 | OSTI; NTIS (US Sales Only); INIS | | DE92711302 | |
| 4881 | 16:34539 | OSTI; NTIS (US Sales Only) | | DE92711542 | |
| 4884 | 16:34008 | OSTI; NTIS (US Sales Only); INIS | | DE92714471 | |
| 4925 | 16:35485 | OSTI; NTIS (US Sales Only); INIS | | DE92714347 | |
| **KFK-PEF–** | | | | | |
| 85 | 16:35060 | OSTI; NTIS (US Sales Only) | | DE92714349 | |
| **KFTI–** | | | | | |
| 88-56 | 16:35309 | OSTI; NTIS (US Sales Only); INIS | | DE91643515 | |
| 89-13 | 16:35403 | OSTI; NTIS (US Sales Only); INIS | | DE91643139 | |
| **KTM/E-B–** | | | | | |
| 100 | 16:34248 | OSTI; NTIS (US Sales Only) | | DE92703970 | |
| 81 | 16:34272 | OSTI; NTIS (US Sales Only) | | DE92703972 | |
| 83 | 16:34776 | OSTI; NTIS (US Sales Only) | | DE92704047 | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 85 | 16:34394 | OSTI; NTIS (US Sales Only) | | DE92703968 | |
| 87 | 16:33604 | OSTI; NTIS (US Sales Only) | | DE92703971 | |
| 89 | 16:33546 | OSTI; NTIS (US Sales Only) | | DE92704051 | |
| 91 | 16:34322 | OSTI; NTIS (US Sales Only) | | DE92703967 | |
| 93 | 16:34323 | OSTI; NTIS (US Sales Only) | | DE92704053 | |
| 95 | 16:34395 | OSTI; NTIS (US Sales Only) | | DE92703966 | |
| 97 | 16:34396 | OSTI; NTIS (US Sales Only) | | DE92704049 | |
| **KU-HCOE-FL2-R–** | | | | | |
| 91-03 | 16:34499 | OSTI; NTIS (US Sales Only); INIS | | DE92601042 | |
| **KURRI-TR–** | | | | | |
| 342 | 16:35105 | OSTI; NTIS (US Sales Only); INIS | | DE92704294 | |
| 344 | 16:34040 | OSTI; NTIS (US Sales Only); INIS | | DE92704333 | |
| 345 | 16:35264 | OSTI; NTIS (US Sales Only); INIS | | DE92713857 | |
| 346 | 16:34762 | OSTI; NTIS (US Sales Only); INIS | | DE92704351 | |
| 347 | 16:35338 | OSTI; NTIS (US Sales Only); INIS | | DE92704335 | |
| 350 | 16:35120 | OSTI; NTIS (US Sales Only); INIS | | DE92713959 | |
| **KUTL–** | | | | | |
| 3 | 16:35486 | OSTI; NTIS (US Sales Only); INIS | | DE92704337 | |
| **LA–** | | | | | |
| 11992-MS | 16:34207 | *See* NUREG/CR–5660 | | | |
| 12129-MS | 16:34953 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000153 | |
| 12149-MS | 16:33727 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91017670 | |
| 12175-MS | 16:35487 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000089 | PC-907 |
| 12184-MS | 16:35141 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018183 | MF-907; MF-908 |
| 12196 | 16:35317 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000694 | MF-705 |
| **LA-UR–** | | | | | |
| 91-1068 | 16:35507 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91011400 | |
| 91-1292 | 16:34500 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91011403 | MF-700; MF-704 |
| 91-1852 | 16:34501 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91014779 | MF-904 |
| 91-2283 | 16:35371 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91016041 | MF-906 |
| 91-2284 | 16:34791 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91016040 | MF-906 |
| 91-2473 | 16:34427 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91016232 | MF-900 |
| 91-2703 | 16:34502 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018037 | MF-704 |
| 91-2765 | 16:33768 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018044 | MF-706 |
| 91-2790 | 16:33814 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018051 | MF-515 |
| 91-2797 | 16:34861 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018049 | MF-940 |
| 91-2800 | 16:34419 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018007 | MF-906 |
| 91-2833 | 16:34847 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000318 | MF-906 |
| 91-2834 | 16:34895 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000317 | MF-906 |
| 91-2860 | 16:35404 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000316 | MF-700 |
| 91-2862 | 16:34565 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000314 | MF-904; MF-910 |
| 91-2876 | 16:35453 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000308 | MF-706 |
| 91-2879 | 16:33815 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000307 | MF-706 |
| 91-2882 | 16:34730 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000306 | MF-910 |
| 91-2887 | 16:33820 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000305 | MF-405 |
| 91-2888 | 16:35372 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000368 | MF-910 |
| 91-2891 | 16:35208 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000259 | MF-414 |
| 91-2911 | 16:35166 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000258 | MF-910 |
| 91-2922 | 16:35310 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000256 | MF-411 |
| 91-2923 | 16:35508 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000254 | MF-905 |
| 91-2924 | 16:35509 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000223 | MF-905 |
| 91-2926 | 16:35233 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000253 | MF-910 |
| 91-2945 | 16:35167 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000250 | |
| 91-2951 | 16:35349 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000249 | MF-405 |
| 91-2957 | 16:35013 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000248 | MF-707 |
| 91-2963 | 16:35168 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000221 | MF-905 |
| 91-2965 | 16:35510 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000220 | MF-905 |
| 91-2968 | 16:35350 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000219 | MF-404 |
| 91-2971 | 16:34979 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000218 | MF-940 |
| 91-2975 | 16:34566 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000215 | MF-404 |
| 91-2988 | 16:35311 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000212 | MF-413 |
| 91-2991 | 16:34397 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000210 | MF-721 |
| 91-3012 | 16:34896 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000208 | MF-910 |
| 91-3013 | 16:34848 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000207 | |
| 91-3014 | 16:33769 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000206 | MF-940 |
| 91-3017 | 16:35454 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000205 | MF-424 |
| 91-3019 | 16:35455 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000199 | MF-712 |
| 91-3023 | 16:35242 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000198 | MF-413 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 91-3028 | 16:34398 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000197 | MF-310 |
| 91-3029 | 16:35456 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000196 | MF-413; MF-423 |
| 91-3038 | 16:35229 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000195 | MF-414 |
| 91-3050 | 16:35096 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000194 | MF-408 |
| 91-3051 | 16:34503 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000193 | MF-404 |
| 91-3052 | 16:34835 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000190 | |
| 91-3058 | 16:34251 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000189 | MF-940 |
| 91-3063 | 16:35234 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000187 | MF-905 |
| 91-3081 | 16:33816 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000183 | MF-700 |
| 91-3091 | 16:34862 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000179 | MF-910 |
| 91-3092 | 16:34897 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000178 | MF-910 |
| 91-3100 | 16:34111 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000176 | MF-906 |
| 91-3102 | 16:34898 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000175 | MF-414 |
| 91-3112 | 16:34899 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000173 | MF-414 |
| 91-3114 | 16:35457 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000172 | MF-424 |
| 91-3115 | 16:35458 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000171 | MF-712 |
| 91-3130 | 16:35459 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000170 | MF-422 |
| 91-3135 | 16:35351 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000169 | MF-705 |
| 91-3136 | 16:35209 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000168 | MF-910 |
| **LBL–** | | | | | |
| 24870 | 16:34324 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000692 | MF-350 |
| 26024 | 16:35265 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000691 | MF-413 |
| 26928 | 16:34504 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000927 | MF-404 |
| 27160 | 16:35214 | *See* SLAC-PUB–4977 | | | |
| 27170-1991 | 16:35014 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000646 | PC-607 |
| 27437 | 16:34863 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000863 | MF-414 |
| 27493 | 16:35511 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000654 | PC-405 |
| 27767 | 16:33770 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000643 | PC-814 |
| 28147-Vol.1 | 16:34325 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000689 | MF-350 |
| 28147-Vol.2 | 16:34326 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000690 | MF-350 |
| 28244 | 16:34505 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000926 | MF-404 |
| 28793 | 16:34327 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000688 | MF-350 |
| 28964 | 16:34506 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000900 | MF-404 |
| 29243 | 16:34864 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000653 | PC-414 |
| 29284 | 16:34540 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000898 | MF-404 |
| 29400 | 16:33910 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000755 | MF-251 |
| 29576 | 16:35561 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000651 | PC-405 |
| 29642 | 16:34411 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000603 | MF-350 |
| 29689 | 16:35061 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000687 | |
| 29700 | 16:35151 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000647 | PC-403 |
| 29734 | 16:35512 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000663 | MF-405 |
| 29749 | 16:34399 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000662 | MF-310 |
| 29798 | 16:34328 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000754 | MF-350 |
| 29810 | 16:34876 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000867 | MF-414 |
| 29819 | 16:34877 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000850 | MF-414 |
| 29826 | 16:34878 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000860 | MF-414 |
| 29830 | 16:34249 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000664 | MF-700 |
| 29851 | 16:34329 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000658 | MF-350 |
| 29943 | 16:34900 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000923 | MF-414 |
| 29944 | 16:34901 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000924 | MF-414 |
| 29947 | 16:34865 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000922 | MF-414 |
| 29976 | 16:34902 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000859 | MF-414 |
| 30041 | 16:34330 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000707 | MF-350 |
| 30065 | 16:34213 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000669 | MF-900 |
| 30112 | 16:34567 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000868 | MF-404 |
| 30148 | 16:34568 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000901 | MF-404 |
| 30223 | 16:34942 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000652 | PC-406 |
| 30313 | 16:34879 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000657 | PC-405 |
| 30401-Pt.1 | 16:34331 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000668 | MF-350 |
| 30401-Pt.2 | 16:34332 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000722 | MF-350 |
| 30459 | 16:34903 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000955 | MF-414 |
| 30477 | 16:34333 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000727 | |
| 30498 | 16:34334 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000715 | MF-350 |
| 30574 | 16:34335 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000667 | MF-350 |
| 30668 | 16:34904 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000656 | PC-414 |
| 30695 | 16:35513 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000650 | PC-405 |
| 30724 | 16:34905 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000648 | PC-414 |
| 30734 | 16:35210 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000853 | MF-414 |
| 30748 | 16:35460 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000655 | PC-421 |
| 30758 | 16:35062 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000721 | MF-402 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 30766 | 16:34880 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000649 | PC-414 |
| 30775 | 16:34336 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000666 | MF-350 |
| 30798 | 16:35266 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000695 | MF-413 |
| 30836 | 16:34400 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000807 | |
| 30849 | 16:35211 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000856 | MF-414 |
| 30908 | 16:34337 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000665 | MF-350 |
| 30928 | 16:34541 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000954 | MF-404 |
| 30948 | 16:34542 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000849 | MF-404 |
| 30953 | 16:35562 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000714 | MF-605 |
| 31008 | 16:34507 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000734 | |
| 31038 | 16:34919 | *See* SSCL–487 | | | |
| 31040 | 16:35212 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000724 | MF-414 |
| 31057 | 16:34508 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000855 | MF-404 |
| 31070 | 16:34943 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000848 | MF-414 |
| 31074 | 16:34509 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000905 | |
| 31075 | 16:34510 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000903 | MF-404 |
| 31078 | 16:34224 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000711 | MF-331 |
| 31085 | 16:34511 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000842 | MF-404 |
| 31086 | 16:34543 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000851 | MF-404 |
| 31097 | 16:35142 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000852 | MF-408 |
| 31118 | 16:35015 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000686 | MF-402 |
| 31125 | 16:35273 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000837 | MF-413; MF-404 |
| 31134 | 16:34774 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000844 | MF-413 |
| 31168 | 16:34944 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000809 | MF-414 |
| 31178 | 16:35215 | *See* SLAC-PUB–5600 | | | |
| 31192 | 16:35243 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000811 | MF-414 |
| 31195 | 16:34906 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000921 | MF-414 |
| 31196 | 16:34907 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000810 | MF-414 |
| 31197 | 16:34908 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000839 | MF-414 |
| 31198 | 16:34881 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000957 | MF-414 |
| 31200 | 16:35180 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000956 | MF-405 |
| 31223 | 16:34544 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000815 | MF-404 |
| **MISC–** | | | | | |
| 90071 | 16:34512 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018831 | |
| 91079 | 16:33739 | *See* DOE/ID–10333 | | | |
| **MPE–** | | | | | |
| 224 | 16:34945 | OSTI; NTIS (US Sales Only); INIS | | DE92711164 | |
| **NAL-TM–** | | | | | |
| 630 | 16:34836 | OSTI; NTIS (US Sales Only) | | DE92709534 | |
| **NAL-TR–** | | | | | |
| 1076 | 16:34353 | OSTI; NTIS (US Sales Only) | | DE92709527 | |
| 1077 | 16:34354 | OSTI; NTIS (US Sales Only) | | DE92709528 | |
| 1080 | 16:34421 | OSTI; NTIS (US Sales Only) | | DE92709529 | |
| 1082 | 16:34355 | OSTI; NTIS (US Sales Only) | | DE92709530 | |
| 1086 | 16:35514 | OSTI; NTIS (US Sales Only) | | DE92709531 | |
| 1087 | 16:34356 | OSTI; NTIS (US Sales Only) | | DE92709532 | |
| 1090 | 16:34425 | OSTI; NTIS (US Sales Only) | | DE92709533 | |
| **NEI-DK–** | | | | | |
| 618 | 16:34412 | OSTI; NTIS (US Sales Only) | | DE92703792 | |
| 619 | 16:34413 | OSTI; NTIS (US Sales Only) | | DE92703793 | |
| 626 | 16:34414 | OSTI; NTIS (US Sales Only) | | DE92703865 | |
| 628 | 16:34415 | OSTI; NTIS (US Sales Only) | | DE92703866 | |
| 629 | 16:34416 | OSTI; NTIS (US Sales Only) | | DE92703867 | |
| 630 | 16:33921 | OSTI; NTIS (US Sales Only) | | DE92703868 | |
| 631 | 16:34422 | OSTI; NTIS (US Sales Only) | | DE92703869 | |
| 632 | 16:34236 | OSTI; NTIS (US Sales Only) | | DE92703870 | |
| 633 | 16:33922 | OSTI; NTIS (US Sales Only) | | DE92703873 | |
| 634 | 16:35360 | OSTI; NTIS (US Sales Only) | | DE92703878 | |
| 635 | 16:35361 | OSTI; NTIS (US Sales Only) | | DE92703879 | |
| 636 | 16:33838 | OSTI; NTIS (US Sales Only) | | DE92703880 | |
| 637 | 16:33850 | OSTI; NTIS (US Sales Only) | | DE92703887 | |
| 638 | 16:35016 | OSTI; NTIS (US Sales Only) | | DE92703888 | |
| 639 | 16:33845 | OSTI; NTIS (US Sales Only) | | DE92703890 | |
| 641 | 16:34417 | OSTI; NTIS (US Sales Only) | | DE92703894 | |
| 642 | 16:33653 | OSTI; NTIS (US Sales Only) | | DE92703895 | |
| 643 | 16:34418 | OSTI; NTIS (US Sales Only) | | DE92703896 | |
| 644 | 16:34401 | OSTI; NTIS (US Sales Only) | | DE92703897 | |
| 645 | 16:33873 | OSTI; NTIS (US Sales Only) | | DE92703898 | |
| 646 | 16:33834 | OSTI; NTIS (US Sales Only) | | DE92703900 | |
| 649 | 16:33874 | OSTI; NTIS (US Sales Only) | | DE92703901 | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **NEI-FI–** | | | | | |
| 147 | 16:33827 | OSTI; NTIS (US Sales Only) | | DE92704027 | |
| 149 | 16:34402 | OSTI; NTIS (US Sales Only) | | DE92704031 | |
| **NIFS–** | | | | | |
| 83 | 16:35405 | OSTI; NTIS (US Sales Only); INIS | | DE92713934 | |
| 84 | 16:35461 | OSTI; NTIS (US Sales Only); INIS | | DE92713935 | |
| 85 | 16:35352 | OSTI; NTIS (US Sales Only); INIS | | DE92713936 | |
| 86 | 16:35406 | OSTI; NTIS (US Sales Only); INIS | | DE92713937 | |
| 87 | 16:35407 | OSTI; NTIS (US Sales Only); INIS | | DE92713938 | |
| 88 | 16:35353 | OSTI; NTIS (US Sales Only); INIS | | DE92713939 | |
| 89 | 16:35408 | OSTI; NTIS (US Sales Only); INIS | | DE92713940 | |
| 90 | 16:35409 | OSTI; NTIS (US Sales Only); INIS | | DE92713941 | |
| **NIFS-DATA–** | | | | | |
| 11 | 16:35267 | OSTI; NTIS (US Sales Only); INIS | | DE92704305 | |
| **NIPER–** | | | | | |
| 508 | 16:33661 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91002252 | PC-122 |
| 533 | 16:33674 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91002250 | PC-125 |
| **NIRS–** | | | | | |
| 29 | 16:35488 | OSTI; NTIS (US Sales Only); INIS | | DE92704341 | |
| **NIRS-AR–** | | | | | |
| 33 | 16:35489 | OSTI; NTIS (US Sales Only); INIS | | DE92704009 | |
| **NIRS-RSD–** | | | | | |
| 92 | 16:35080 | OSTI; NTIS (US Sales Only); INIS | | DE92704017 | |
| 93 | 16:35108 | OSTI; NTIS (US Sales Only); INIS | | DE92704015 | |
| **NUKEM-FuE–** | | | | | |
| 90013 | 16:34014 | OSTI; NTIS (US Sales Only); INIS | | DE92714355 | |
| **NUREG–** | | | | | |
| 0040-Vol.15-No.2 | 16:34029 | OSTI; NTIS; INIS; GPO | | TI92000154 | |
| 0540-Vol.13-No.7 | 16:34030 | OSTI; NTIS; INIS; GPO | | TI92000084 | |
| 0750-Vol.33-No.6 | 16:34031 | OSTI; NTIS; INIS; GPO | | TI91018428 | |
| 0750-Vol.34-No.1 | 16:34032 | OSTI; NTIS; INIS; GPO | | TI92000676 | |
| 1272-Vol.5-No.2 | 16:33808 | OSTI; NTIS; INIS; GPO | | TI91017818 | |
| **NUREG/CR–** | | | | | |
| 2000-Vol.10-No.8 | 16:34033 | OSTI; NTIS; INIS; GPO | | TI92000593 | |
| 4219-Vol.7-No.2 | 16:34203 | OSTI; NTIS; INIS; GPO | | TI91019000 | |
| 4469-Vol.11 | 16:34034 | OSTI; NTIS; INIS; GPO | | TI91018427 | |
| 4674-Vol.13 | 16:34204 | OSTI; NTIS; INIS; GPO | | TI91018315 | |
| 4674-Vol.14 | 16:34205 | OSTI; NTIS; INIS; GPO | | TI91019011 | |
| 5606 | 16:34206 | OSTI; NTIS; INIS; GPO | | TI91017817 | |
| 5660 | 16:34207 | OSTI; NTIS; INIS; GPO | | TI92000104 | |
| 5696 | 16:33990 | OSTI; NTIS; INIS; GPO | | TI91018983 | |
| **NUREG/GR–** | | | | | |
| 0002 | 16:34513 | OSTI; NTIS; GPO | | TI92000545 | |
| **NYSERDA–** | | | | | |
| 91-5 | 16:34357 | OSTI; New York State Energy Research and Development Authority, Two Rockfeller Plaza, Albany, NY 12223 | | TI91018975 | |
| **ORNL–** | | | | | |
| 6624 | 16:35411 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000388 | PC-420 |
| 6661 | 16:34244 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000414 | MF-400 |
| 6672/S1 | 16:34358 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000520 | MF-330 |
| 6681 | 16:35490 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000403 | MF-900 |
| **ORNL/ATD–** | | | | | |
| 54 | 16:34569 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000710 | MF-404 |
| **ORNL/CCIP–** | | | | | |
| 91/25 | 16:35230 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000449 | MF-413 |
| **ORNL/CON–** | | | | | |
| 262 | 16:34338 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000381 | MF-350 |
| **ORNL/CSD/TM–** | | | | | |
| 269/R1 | 16:34970 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000413 | |
| 282 | 16:34596 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018610 | |
| **ORNL/ER–** | | | | | |
| 17 | 16:35081 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000418 | MF-902 |
| 52 | 16:33797 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018993 | MF-940 |
| **ORNL/M–** | | | | | |
| 1156 | 16:35082 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000422 | MF-402 |
| 1524 | 16:33973 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91016845 | MF-114 |
| 1677 | 16:34792 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018510 | MF-406 |
| **ORNL/NOAC–** | | | | | |
| 232-Vol.13 | 16:34204 | *See* NUREG/CR–4674-Vol.13 | | | |
| 232-Vol.14 | 16:34205 | *See* NUREG/CR–4674-Vol.14 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **ORNL/NSIC–** | | | | | |
| 200-Vol.10-No.8 | 16:34033 | *See* NUREG/CR–2000-Vol.10-No.8 | | | |
| **ORNL/NSP–** | | | | | |
| 91/1 | 16:33984 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018523 | MF-500 |
| **ORNL/Sub–** | | | | | |
| 88-SB775/02 | 16:33974 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017158 | MF-114 |
| 90-89673 | 16:34339 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000384 | MF-350 |
| **ORNL/TM–** | | | | | |
| 11582 | 16:34221 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000416 | |
| 11668/V1 | 16:34340 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000380 | MF-350 |
| 11668/V3 | 16:34341 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000412 | MF-350 |
| 11680 | 16:34971 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000411 | |
| 11716 | 16:34053 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018316 | PC-530 |
| 11739 | 16:35469 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000379 | PC-424 |
| 11781 | 16:35470 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000390 | PC-424 |
| 11804 | 16:33990 | *See* NUREG/CR–5696 | | | |
| 11850 | 16:35515 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000386 | MF-405 |
| 11856 | 16:33727 | *See* LA–12149-MS | | | |
| 11881 | 16:34775 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000383 | MF-407 |
| 11893 | 16:33975 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000281 | MF-114 |
| 11895 | 16:35017 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000385 | MF-405; MF-402 |
| 11897 | 16:35152 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000453 | MF-403 |
| 11910 | 16:35516 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018521 | |
| 11924 | 16:35097 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000282 | MF-408 |
| 9593-Vol.7-No.2 | 16:34203 | *See* NUREG/CR–4219-Vol.7-No.2 | | | |
| **ORNL/tr–** | | | | | |
| 90/25 | 16:34793 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017787 | MF-401 |
| 91-8 | 16:34794 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017722 | MF-406 |
| 91-9 | 16:35477 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017792 | MF-404 |
| 91-13 | 16:35478 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017723 | MF-404 |
| 91/29 | 16:34545 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018514 | MF-404 |
| 91/3 | 16:34208 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018519 | MF-520 |
| 91/6 | 16:34731 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018403 | MF-401 |
| 91/7 | 16:35476 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017793 | MF-404 |
| **OY/PSTL-TIED–** | | | | | |
| 75 | 16:33605 | OSTI; NTIS (US Sales Only) | | DE92703997 | |
| **P–** | | | | | |
| 300-91-019 | 16:33668 | OSTI; CEC, Publications Unit, 1516 Ninth Street-MS13, Sacramento, CA 95814 | | TI91018784 | |
| **PATENTS-** | | | | | |
| | 16:33662 | Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN | | | |
| | 16:33720 | Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN | | | |
| | 16:34423 | Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN | | | |
| | 16:34424 | Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN | | | |
| | 16:34426 | Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN | | | |
| **PATENTS-US–** | | | | | |
| A7244758 | 16:33585 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017341 | MF-115 |
| **PETC–** | | | | | |
| 2-3-91 | 16:33570 | *See* DOE/PC/89876–T3 | | | |
| **PNL–** | | | | | |
| 5711-Vol.11 | 16:34034 | *See* NUREG/CR–4469-Vol.11 | | | |
| 7540 | 16:34997 | *See* DOE/RL–01830T-H6 | | | |
| 7542 | 16:33849 | *See* DOE/RL–01830T-H9 | | | |
| 7550 | 16:33771 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018293 | MF-721 |
| 7564 | 16:35000 | *See* DOE/RL–01830T-H12 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 7565 | 16:35001 | *See* DOE/RL–01830T-H13 | | | |
| 7656 | 16:34342 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018961 | MF-920 |
| 7718 | 16:33772 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019018 | MF-610 |
| 7785 | 16:33809 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000391 | MF-606 |
| 7787 | 16:35063 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018654 | MF-902 |
| 7789 | 16:33918 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018887 | MF-261 |
| 7790 | 16:35064 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000165 | |
| 7793 | 16:34343 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000039 | MF-350 |
| 7794 | 16:33914 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000031 | MF-254 |
| 7807 | 16:34403 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000163 | MF-310 |
| 7825 | 16:34209 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000436 | MF-610 |
| **PNL-SA–** | | | | | |
| 16927 | 16:34546 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000225 | MF-404; MF-406 |
| 17644 | 16:33598 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000796 | MF-102; MF-401 |
| 19432 | 16:34972 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018471 | MF-700 |
| 19469 | 16:35065 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000147 | MF-902 |
| 19624 | 16:34404 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018221 | MF-502 |
| 19646 | 16:35083 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000799 | MF-902 |
| 19650 | 16:33828 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018220 | MF-413 |
| 19657 | 16:34344 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000392 | MF-350 |
| 19728 | 16:34027 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000142 | MF-528 |
| 19765 | 16:35181 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018219 | MF-310 |
| 19771 | 16:34214 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000143 | MF-528 |
| 19812 | 16:34597 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018473 | MF-501 |
| 19841 | 16:34946 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000393 | MF-506 |
| 19894 | 16:33819 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000146 | MF-902 |
| 19901 | 16:35106 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018824 | MF-408; MF-404 |
| 19908 | 16:33773 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000057 | MF-940 |
| 19923 | 16:35517 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018823 | MF-400 |
| **PNL-TR–** | | | | | |
| 485 | 16:34598 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91017839 | MF-510 |
| **POEF–** | | | | | |
| 2070 | 16:34233 | *See* ES/ESH–18/V4 | | | |
| **POEF-T–** | | | | | |
| 3565 | 16:33722 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018897 | MF-504 |
| 3566 | 16:33732 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018899 | MF-506 |
| 3567 | 16:33733 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018898 | MF-506 |
| 3569 | 16:34795 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018901 | MF-513; MF-517 |
| 3574 | 16:34796 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018896 | MF-714 |
| **PRC–** | | | | | |
| 91-02 | 16:34932 | *See* DESY–91-026 | | | |
| **PWA–** | | | | | |
| 01/91 | 16:34594 | *See* KFK–4590 | | | |
| 16/91 | 16:33813 | *See* KFK–4866 | | | |
| **RFP–** | | | | | |
| 4451 | 16:35018 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018395 | MF-702 |
| 4459 | 16:34797 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018556 | MF-706 |
| 4498 | 16:34514 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017756 | MF-704 |
| 4500 | 16:35084 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018962 | MF-702 |
| **RFP-Trans–** | | | | | |
| 502 | 16:33774 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018402 | MF-706 |
| 503 | 16:34058 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018406 | MF-700 |
| 504 | 16:34041 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018404 | MF-702 |
| 505 | 16:33775 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018405 | MF-701 |
| 507 | 16:34515 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018407 | MF-706 |
| 514 | 16:34798 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017834 | MF-706 |
| 515 | 16:34840 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018409 | MF-706; MF-704 |
| 516 | 16:34042 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018485 | MF-706 |
| 520 | 16:34799 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018515 | MF-706 |
| **RISO-M–** | | | | | |
| 2879 | 16:33919 | OSTI; NTIS (US Sales Only) | | DE92703790 | |
| **RLO–** | | | | | |
| 2227-T12-47 | 16:35085 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000516 | MF-403 |
| **RSI–** | | | | | |
| 0338 | 16:33736 | *See* DOE/CH/10378–9 | | | |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| **RTI-DCS–** | | | | | |
| 90-03 | 16:33982 | *See* ENEA-RTI-DCS–90-03 | | | |
| **RTI-FARE–** | | | | | |
| 90-18 | 16:33867 | *See* ENEA-RTI-FARE–90-18 | | | |
| **RTI-INN–** | | | | | |
| 91-02 | 16:34859 | *See* ENEA-RTI-INN–91-02 | | | |
| 91-04 | 16:35439 | *See* ENEA-RTI-INN–91-04 | | | |
| 91-11 | 16:34530 | *See* ENEA-RTI-INN–91-11 | | | |
| **RTI-INT–** | | | | | |
| 91-01 | 16:34373 | *See* ENEA-RTI-INT–91-01 | | | |
| **RTI/STUDI-STRAT–** | | | | | |
| 90-8 | 16:34227 | *See* ENEA-RTI-STUDI-STRAT–90-08 | | | |
| **Risley-Trans–** | | | | | |
| 6062 | 16:34009 | OSTI; NTIS (US Sales Only); INIS | | DE92601464 | |
| 6064 | 16:34010 | OSTI; NTIS (US Sales Only); INIS | | DE92601465 | |
| 6066 | 16:33776 | OSTI; NTIS (US Sales Only); INIS | | DE92601517 | |
| **SAND–** | | | | | |
| 89-0167C | 16:34951 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018353 | MF-706; MF-704 |
| 90-0707C | 16:33777 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018676 | MF-902 |
| 90-1785 | 16:33778 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91015645 | MF-721 |
| 90-1906 | 16:34976 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017923 | MF-700 |
| 90-1970 | 16:34206 | *See* NUREG/CR–5606 | | | |
| 90-2081 | 16:33779 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91016057 | MF-721 |
| 90-2367 | 16:33780 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91015644 | MF-721 |
| 90-2535 | 16:34210 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000090 | PC-523 |
| 90-3101C | 16:34849 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018797 | MF-706 |
| 91-0025/1 | 16:33781 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91019015 | MF-814 |
| 91-0025/2 | 16:33782 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91019016 | MF-814 |
| 91-0077 | 16:33817 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000191 | PC-820 |
| 91-0105 | 16:33783 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018624 | PC-900; PC-902 |
| 91-0130 | 16:34225 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000609 | MF-700 |
| 91-0178C | 16:34909 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018359 | MF-706 |
| 91-0364C | 16:34977 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018354 | MF-706 |
| 91-0491C | 16:34800 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018358 | MF-700 |
| 91-0648C | 16:34570 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019065 | MF-704 |
| 91-0653C | 16:34571 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91010582 | MF-700 |
| 91-0741C | 16:34850 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018811 | MF-706 |
| 91-0828C | 16:34831 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018350 | MF-705; MF-706 |
| 91-0913C | 16:33784 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000234 | MF-902 |
| 91-0980C | 16:33654 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017452 | MF-122 |
| 91-0995C | 16:34572 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000997 | MF-704 |
| 91-1004 | 16:35518 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000150 | MF-705 |
| 91-1021C | 16:33785 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018673 | MF-703 |
| 91-1037 | 16:35519 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018889 | MF-700 |
| 91-1104 | 16:33655 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017219 | MF-126 |
| 91-1124 | 16:33963 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000597 | MF-261 |
| 91-1167 | 16:35563 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000607 | MF-906 |
| 91-1168 | 16:35520 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000608 | MF-705 |
| 91-1188C | 16:34573 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018813 | MF-706 |
| 91-1252C | 16:35521 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91013107 | MF-705 |
| 91-1340C | 16:35491 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91015336 | MF-706 |
| 91-1374C | 16:34837 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000242 | MF-743 |
| 91-1463 | 16:33586 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018127 | MF-108 |
| 91-1509C | 16:34516 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017981 | MF-704; MF-706 |
| 91-1548 | 16:34801 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000611 | MF-406 |
| 91-1551C | 16:34574 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017999 | MF-704 |
| 91-1620C | 16:34802 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000818 | MF-906; MF-902 |
| 91-1637C | 16:33587 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019055 | MF-108 |
| 91-1694C | 16:33911 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019063 | MF-251 |
| 91-1726C | 16:34851 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018679 | MF-706 |
| 91-1738C | 16:33786 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91019067 | MF-940 |
| 91-1756C | 16:34803 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018814 | MF-706 |
| 91-1840 | 16:34245 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000592 | PC-700 |
| 91-1843C | 16:34517 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018397 | MF-706 |
| 91-1847C | 16:34575 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91016219 | MF-401 |
| 91-1861C | 16:35355 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018794 | MF-704 |

| Report Number | Abstract Number | Source of Availability | GPO Dep. | Order Number | Distribution Category |
|---|---|---|---|---|---|
| 91-1865 | 16:34969 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018582 | MF-906 |
| 91-1872C | 16:33787 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018810 | MF-902 |
| 91-1883C | 16:34576 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018318 | MF-704 |
| 91-1894C | 16:34405 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017984 | MF-900 |
| 91-1921C | 16:35522 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91017847 | MF-705 |
| 91-1940C | 16:34406 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019056 | MF-706 |
| 91-1953C | 16:34852 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018685 | MF-706 |
| 91-1964C | 16:35523 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019066 | MF-906 |
| 91-1975C | 16:34867 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018812 | MF-900 |
| 91-1987C | 16:34112 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018351 | MF-706 |
| 91-1992C | 16:34577 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019057 | MF-706 |
| 91-2014C | 16:34578 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91019061 | MF-506 |
| 91-2046C | 16:34957 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019062 | MF-706 |
| 91-2047C | 16:34958 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019059 | MF-706; MF-704 |
| 91-2078C | 16:34853 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019058 | MF-706 |
| 91-2090C | 16:35492 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019051 | MF-902 |
| 91-2113C | 16:35312 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91019064 | MF-706 |
| 91-2115C | 16:35524 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000246 | MF-705 |
| 91-2116C | 16:35525 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000245 | MF-905 |
| 91-2189C | 16:34973 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000228 | MF-706 |
| 91-2257C | 16:35526 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE92000952 | |
| 91-2850C | 16:34854 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018815 | MF-706 |
| 91-7001 | 16:33900 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000605 | MF-275 |
| 91-7007 | 16:33901 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000604 | MF-237 |
| 91-7030C | 16:33788 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000792 | MF-814 |
| 91-7081C | 16:33588 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000793 | MF-108 |
| **SC-MAG–** | | | | | |
| 315 | 16:34876 | *See* LBL–29810 | | | |
| 316 | 16:34877 | *See* LBL–29819 | | | |
| 317 | 16:34878 | *See* LBL–29826 | | | |
| 328 | 16:34879 | *See* LBL–30313 | | | |
| 336 | 16:34904 | *See* LBL–30668 | | | |
| 337 | 16:34880 | *See* LBL–30766 | | | |
| **SDC–** | | | | | |
| 91-00051 | 16:35188 | *See* ANL-HEP-TR–91-70 | | | |
| 91-00081 | 16:35189 | *See* ANL-HEP-TR–91-74 | | | |
| 91-00083 | 16:35190 | *See* ANL-HEP-TR–91-78 | | | |
| **SERI/CP–** | | | | | |
| 2360-4494 | 16:33855 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91015008 | MF-248 |
| **SERI/TP–** | | | | | |
| 214-4405 | 16:33856 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91015002 | MF-271 |
| 250-4474 | 16:33899 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91015007 | MF-234 |
| 257-4123 | 16:33964 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91002199 | MF-261 |
| **SLAC–** | | | | | |
| 381 | 16:35213 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91019004 | PC-414 |
| **SLAC-PUB–** | | | | | |
| 4977 | 16:35214 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000939 | MF-414 |
| 5400 | 16:35196 | *See* DESY–91-051 | | | |
| 5587 | 16:34910 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018879 | MF-414 |
| 5600 | 16:35215 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018884 | MF-414 |
| 5619 | 16:35216 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000236 | MF-414 |
| 5631 | 16:34911 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018881 | MF-404 |
| 5651 | 16:34868 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000237 | MF-414 |
| 5655 | 16:34947 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000938 | MF-413 |
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| 3890 | 16:35493 | OSTI; NTIS (US Sales Only); INIS | | DE92601581 | |
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| 364 | 16:34912 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000461 | MF-414 |
| 391 | 16:34913 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018734 | MF-414 |
| 396 | 16:34869 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018733 | MF-414 |
| 403 | 16:34914 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92001661 | MF-414 |
| 404 | 16:34915 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92001660 | MF-414 |
| 405 | 16:34916 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92001659 | MF-414 |
| 406 | 16:34917 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92001658 | MF-414 |
| 484 | 16:34918 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92001606 | PC-414 |
| 487 | 16:34919 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000460 | MF-414 |
| 500 | 16:34882 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92001607 | PC-414 |
| 507 | 16:34883 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000370 | MF-414 |
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| B28 | 16:34345 | OSTI; NTIS (US Sales Only) | | DE92704038 | |

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| 65 | 16:34346 | OSTI; NTIS (US Sales Only) | | DE92704036 | |
| 69 | 16:34832 | OSTI; NTIS (US Sales Only) | | DE92704034 | |
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| 91/5 | 16:34059 | OSTI; NTIS | | DE91015963 | |
| **TYOT-JULK–** | | | | | |
| 318 | 16:33915 | OSTI; NTIS (US Sales Only) | | DE92704001 | |
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| 91/43 | 16:35243 | *See* LBL–31192 | | | |
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| 16986-91-1/2 | 16:33718 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018658 | MF-123 |
| 17026-Rev.3 | 16:35527 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000475 | MF-705 |
| 19227-90 | 16:34270 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018657 | MF-121 |
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| 107134 | 16:34959 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018997 | MF-706 |
| 107270 | 16:34804 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018996 | MF-406 |
| 107853 | 16:35182 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019009 | MF-706 |
| 107856 | 16:35373 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019014 | MF-705 |
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| 105163 | 16:33789 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000098 | MF-814 |
| 106094 | 16:35474 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000093 | MF-712 |
| 106159 | 16:33790 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000102 | MF-814 |
| 107112-Pt.2 | 16:35374 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018489 | MF-706 |
| 107225 | 16:34547 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000476 | MF-704 |
| 107485 | 16:34982 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018660 | MF-700 |
| 107566 | 16:34952 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91019019 | MF-706 |
| 107877 | 16:34732 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018659 | MF-700 |
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| 108258 | 16:34838 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000099 | MF-706 |
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| 106334 | 16:35020 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018467 | MF-702 |
| 106887 | 16:35356 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018461 | MF-700 |
| 106888 | 16:34960 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018460 | MF-706 |
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| 106995 | 16:35564 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91016606 | MF-700 |
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| 107669 | 16:34948 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018465 | MF-707; MF-706 |
| 107839 | 16:34518 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018999 | MF-706 |
| 107941 | 16:34980 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018725 | MF-742 |
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| 108064 | 16:35087 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000488 | MF-703 |
| 108142 | 16:35153 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018722 | MF-403 |
| 108197 | 16:35529 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018721 | MF-705 |
| 108312 | 16:34978 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000490 | MF-704 |
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| 107714 | 16:35174 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018653 | MF-700 |
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| 105401 | 16:35531 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91019012 | MF-706; MF-705 |

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| 106459 | 16:34519 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018410 | MF-704 |
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| 90-28 | 16:35268 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018757 | MF-413 |
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| 91-4047 | 16:35075 | *See* DOE/ID–22096 | | | |
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| 91/09 | 16:35230 | *See* ORNL/CCIP–91/25 | | | |
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| A64 | 16:33719 | OSTI; NTIS (US Sales Only) | | DE92703991 | |
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| 91-10 | 16:33831 | OSTI; NTIS; GPO Dep. | E 1.99: | DE92000585 | MF-241 |
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| 0145-3 | 16:35022 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018137 | MF-940 |
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| 0363-Rev.1 | 16:33794 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000528 | MF-940 |
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| 0445 | 16:33798 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000233 | MF-902 |
| 0506 | 16:35565 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE92000529 | MF-800; MF-810 |
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| 0187 | 16:33728 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018155 | MF-706; MF-701 |
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| 1019 | 16:35533 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018165 | MF-902 |
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| 1074 | 16:34211 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91017736 | MF-520 |
| 1088 | 16:34026 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91017738 | MF-520 |
| 1129 | 16:33818 | OSTI; NTIS (US Sales Only); GPO Dep. | E 1.99: | DE91018141 | MF-700 |
| 1170 | 16:33729 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91018153 | MF-711 |
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| 91-7 | 16:34265 | OSTI (Free of Charge) | | TI91019022 | PC-950 |
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| 142 | 16:33796 | OSTI; NTIS; INIS; GPO Dep. | E 1.99: | DE91017642 | MF-703 |

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| 90/13 | 16:33723 | OSTI; NTIS; GPO Dep. | E 1.99: | DE91018437 | MF-704 |
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| DE92000234 | SAND-91-0913C |
| DE92000236 | SLAC-PUB-5619 |
| DE92000237 | SLAC-PUB-5651 |
| DE92000239 | ANL/CP-73909 |
| DE92000242 | SAND-91-1374C |
| DE92000244 | DOE/RL-91-47 |
| DE92000245 | SAND-91-2116C |
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| DE92000266 | DOE/BC/14473-6 |
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| DE92000282 | ORNL/TM-11924 |
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| DE92000461 | SSCL-364 |
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| DE92000638 | FNAL/C–91/234-E |
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TO Tonga
TR Turkey
TT Trinidad and Tobago
TW Taiwan
TZ United Republic of Tanzania

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UG Uganda
US United States of America (USA)
UY Uruguay

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VE Venezuela
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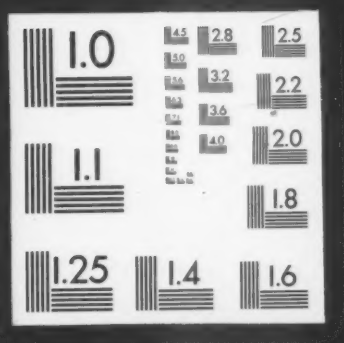
1.0
1.1
1.25
1.4
1.6
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.8